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## MUNICIPAL LIGHTING IN NEW YORK.

To what extent the public of New York is interested in the proposal to establish a municipal electric light plant, it is difficult to ascertain. We have watched the daily papers in vain for any evidence that it cares in the least, or attaches the slightest importance to the figures and statements put forward in favor of the scheme by its chief advocates, in one or two of the city departments. The daily newspapers themselves betray no enthusiasm on the subject, one or two of them being chiefly occupied with a gas campaign, and others opposing the idea more or less directly. We cannot ascertain that the Mayor is in favor of the scheme; in fact, it is believed he is not very anxious about it, although rather free use of his name appears to have been made by his official associates. We are forced to the conviction that outside two or three city officials, a few busybodies, and a coterie of speculators on the Stock Exchange, no one is discussing with any earnestness the idea that the city should invest large sums of money of its own in an electric lighting plant. It is true that Commissioner Monroe gets a hearty reception from the Order of Acorns when he says that the city should have an isolated plant, just as hotels and office buildings have; but the argument is not pertinent nor is the Order of Acorns particularly well informed on the subject of lighting or the history of American municipal enterprises. It is, on the other hand, unfortunate that this movement should be associated with deliberate and painstaking efforts to depress the value of lighting securities on the Stock Exchange, the market acting as though the city itself were selling short so as to pay for the plant out of the profits of its bear gamble "in the street." The *Wall Street Journal*, too, makes the theme occasion for a long article showing how easily and cheaply the system could be duplicated, and how much "water" there is in its stocks. We are not concerned to defend the Brady methods of financing, and are willing to admit that they are not to our way of liking as a usual thing; but when we remember that the city electric lighting is a bare 5 per cent. of the New York Edison business, it will be seen that ulterior motives might well inspire this irrelevant "drive" in financial circles and organs at the securities in question, quite regardless of the merits of the municipal plant problem.

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Possibly the public sees this, too. Possibly the public is also not anxious to increase the number of city departments, city enterprises, city officials and the city pay-roll. Possibly the citizens do not overlook the fact that this same department asking for control of a lighting plant handles its water supply so badly that thousands of New Yorkers buy other drinking water in order to be safe, and are often unable to bathe, so laden with dirt and impurities is the city supply furnished them. This has gone on for years. Possibly the public wonders whether it would be likely to get better city light than it gets city water, or whether the one supply would be handled any more economically and efficiently than the other has been, lo, these many years. It might be better to get the water supply right before assuming these other serious obligations.

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We have before us that report made to Commissioner Monroe by Mr. Lacombe, engineer of the department, as to what might and ought to be done with a city plant. As to how this was got together, Mr. Monroe said to the Acorns:

But this year I sent to 175 cities in every part of the United States for the purpose of ascertaining what price they paid for their lighting. When about 100 replies had been received and the results

tabulated, I found that only in exceptional cases did any city come within 10 per cent. of what we paid; that only few came within 30 per cent., and that a great many paid less than 50 per cent. of what we were paying. While in most cities $86 was the price per annum for one light of 2,000 cp, which is the standard size used, we paid $146 a year. In looking about for a reason for this large difference, I came to the conclusion that where a corporation owned a city the price was high, and that where the governments were in a position to insist that the interests of the city should be safeguarded, the price was low.

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We cannot say that such figure-collecting inspires us with any confidence, and an examination of the figures, to which we shall probably return later, reveals a mass of "data" of the most suspicious and untrustworthy character, including some of the old municipal lighting yarns which are simply and utterly false, or else offer no possible basis of comparison on even terms. If Mr. Monroe really wants figures on arc lighting they can be got, we think, right in this town. It is a matter of notoriety among electrical engineers that arc lighting, by itself, long since ceased to be an item of important profit to any large central station. Unless the old arc companies had taken up power and incandescent lighting, many would have had to go out of business long ago. It is also an open secret, we believe, that in New York City, since the introduction of the subways, the old Brush system and possibly the other arc networks, have never been able to make ends meet, or show any profit. In other words, they are carried by the business done in other branches. Yet the city is invited to go directly into an enterprise which presents the strictest analogy to that now operating at a loss, despite the fact that it has so many years of experience behind it and the services of trained men, who, if anybody could, ought to be able to make mere arc lighting pay. We do not know whether the figures are available, but we do know that we would rather depend on them than on any loose data, unchecked and unconfirmed, from 100 out of the 3,000 central station systems in this country.

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We venture to suggest, at this juncture, to the Department of Gas, Water and Electricity, of New York, that if it wants to get a lower rate for arc lighting, that might be easily obtained by effecting with the company a long-term contract. Many of the lower rates it could quote were secured in that manner, and it stands to reason that any company would make reasonable concessions on such a basis where on a precarious renewal from year to year it has to protect itself against loss involved in purchase of dynamos, lamps, poles, cables, etc., which would only be required for a brief twelve months. This is so obvious it should not require statement, but it certainly does seem to have been lost sight of in the present "agitation."

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We objected above to Commissioner Monroe's analogy between a municipal plant for the city and an ordinary isolated plant. It is, indeed, a most misleading analogy, quite aside from the fact that most or all central station men dispute the assumption that isolated plants need exist in central station areas. But an isolated plant, as Mr. Monroe speaks of it, is for one building or a restricted area. In this instance, however, we are dealing with an area of a great many square miles with circuits in every direction along which lights would be scattered very sparsely, only a few to each mile. We could understand the use of the analogy if the city were proposing, for example, to light the city hall alone; but if the city has one building to light, it must have scores and scores; and the use of the phrase "isolated plant" for the central station plan involved is most decidedly objectionable, and whatever idea of economy it is intended to convey thereby must be dismissed from the argument.

## THE PRINCIPLE OF A NEW METHOD OF ELECTRIC LIGHTING.

We print in this number, on page 517, an article by M. Paul Hoho on a new type of electric lamp. M. Hoho distinguishes his lamp from an arc lamp, or a mercury vapor lamp, owing to the radically different physical conditions under which it is produced. He submerges his cathode in water, or in a weak aqueous solution of some salt, and forces a fairly powerful current through it. Under these circumstances the cathode becomes surrounded with a gaseous layer which is presumably of hydrogen, and the resistance of this layer of gas is so great that the energy expended in it by joulean effect raises the temperature to a very high degree. Consequently, it would seem that the Hoho lamp is a particular form of arc lamp. In the carbon arc lamp it is the resistance of a layer of carbon vapor which gives rises to the local expenditure of heat energy. In the mercury vapor arc lamp it is the resistance of a much longer column of mercury vapor that produces the energy. In the Hoho lamp it is the resistance of a layer of hydrogen, or other gas, which serves the same purpose.

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It must be confessed that since we are accustomed to throw hot things, such as red-hot rivets, into a bucket of water in order to cool them, there is something paradoxical, to the ordinary mind, in submerging a rivet, with a pair of electrically-conducting tongs, into a bucket of cold salt water, in order to heat it in a few seconds to the temperature of vivid incandescence. Yet the experiment is very readily performed with 220-volt mains, and it has even been proposed to heat rivets electrically in this manner, in places where it was inconvenient to employ the ordinary riveter's forge. We are not aware, however, that the plan has come into commercial use, although it might do so at any time when the conditions for electric heating are more convenient than for forge-heating. M. Hoho states his reasons for believing that a higher temperature can be attained at the cathode in his bath than by any other existing artificial means, including even the electric carbon arc. If this is the case, the apparatus should have important use in that department of experimental physics where the highest temperatures are desired.

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All of the difficulties related in the article seem to be connected with the very high temperature attainable in the bath, and the all-too-ready fusibility of even platinum or iridium. He even seems to think that he melts carbon. It has been supposed by various experimenters that carbon softens and melts at a temperature not far from that of its volatilization. The best material that he has been able to find is one on which he has to keep water dropping during the continuance of the current. If it were possible to find a sufficiently infusible substance that had conducting power, the highest temperature attainable would form a most interesting subject for measurement. The illustration in the article indicates that the lamp is really a hot cathode in a bucket of water, and the hot cathode appears to be semi-submerged. To most persons unfamiliar with the subject it would seem incredible that such an apparatus could produce an extraordinarily high temperature; yet the proposition is not at all unlikely.

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## THE INDUCTION COIL.

The induction coil, using the term in its most general sense, is one of the most important pieces of apparatus in the whole range of electrical engineering. In electric lighting and power transmission, we employ it under the title of the transformer, both to lower and to raise the pressure, as the case may require. In these conditions there is sought and secured a high efficiency combined with good regulation. In telephony the apparatus is used to raise the pressure and increase the range of telephonic transmission. In

telegraphy it has a few special applications. In wireless telegraphy it is also used to raise the pressure in the sending circuit as well as to assist in tuning the local receiving circuit. In a great variety of minor utilities, such as gas-igniters, the induction coil is again applied. Moreover, whenever a very high electric pressure is desired, which does not need to be steadily maintained, as in the operation of Röntgen-ray tubes, Crookes tubes and Geissler tubes, the induction coil comes to the rescue.

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In some of the applications above outlined, the induction coil has been with us for half a century. And yet, although we can make satisfactory coils for various needs, our theory of the induction coil is very meagre and incomplete. There are great gaps in it. Some of the conditions are so seemingly complex that we are unable to bring them within the reach of arithmetic; as, for example, the law of the resistance in the spark-gap of the interrupter, or the law of the distributed capacity in the windings. We can design transformers with a very fair degree of certainty; but in the design of a spark-coil for a given maximum voltage, or a given spark length, we are still very much at sea, and have to depend upon empirical rules, and on cutting and trying. Dr. Ives' article, on page 513 works in the direction of improving the theory of the induction coil, both from the mathematical and from the experimental side.

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A very important generalization is that which expresses the maximum secondary voltage as the product of the primary current into a virtual resistance of an alternating circuit containing a distributed inductance equal to that of the secondary and a distributed lateral capacity equal to that of the condenser across the gap. According to this theory, assumed correct, the induction coil primary behaves like a transmission line having the inductance of the primary and the distributed capacity of the condenser, so that the virtual resistance is the square root of the ratio of these quantities. The drop in this virtual resistance with the actual strength of current at the instant of breaking is the magnitude of the primary prssure, and which is transferred to secondary terminal in the ratio of transformation. No theory of the induction coil can, however, hope to be reliable until the influence of distributed capacity in the windings can be estimated and taken into account. Some of the phenomena of the induction coil are, in fact, directly opposed to the ordinary elementary theory, by reason of the effects of this distributed capacity. It is earnestly to be hoped that such researches as these may be steadily advanced, owing to the great industrial importance of their application to the design of powerful induction coils.

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### THE TESLA SPLIT-PHASE PATENT DECISIONS.

The recent decisions against the validity of the Tesla split-phase patent bring food for thought. It is not our purpose here to go into the merits of the case, for these are in the domain of the court; nor do we have any immediate interest in the bearing of this particular decision or others involving similar issues. Those best informed on the state of the art have long considered the split-phase motor patent as the weakest link in the chain of Tesla patents, so that the present decision is not altogether surprising and perhaps not unexpected. We have always regretted that the fundamental polyphase patents have not been fought to a finish, for the issues are important, and in the interest of fair play to the inventor and the public, it would have been a desirable thing to have them finally settled. The claims of Ferraris, which proved effective abroad, were of course blocked here by statute. Our patent law wisely and properly relieves the American inventor from the serious burden of defending himself against attacks based on unpublished work in foreign countries. In this instance the rule may have worked some hardship to Ferraris, but without it the American inventor would have to fight his rights clear around the world against any litigant with money and pertinacity enough to keep the ball rolling. The telephone patent and to a certain extent the incandescent lamp patents, scored against foreign claimants in a similar fashion, but quite aside from the merits of individual cases, we believe that revocation of the rule would work greater injustice than its continuance.

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There is, however, serious ground for dissatisfaction in the outrageous amount of time which generally elapses before an important patent reaches the court of last resort and is sustained or invalidated. In this Tesla case the patent is nearing its end before the adverse decision comes. If this decision is sound it ought in justice to the public to have been reached years ago; or if unsound it should have long ago been made impossible by the weight of favoring decisions. The fact is that in a case of any considerable importance the public does not know whether it is infringing or not until the patent is moribund or dead and buried. The telephone cases seemed interminable and the Berliner part of the matter, a quarter of a century old, could be yet revived by the United States Supreme Court ordering the case before it. Litigations clustered about the deathbed of the incandescent lamp patents and at the tomb came the notorious Goebel defence which, in justice to the public, ought to have prevailed fifteen years before or not at all. No sane man really believes that the facts were hidden from human view and forgotten through all those years of turmoil and recrimination. If an inventor has any rights to his monopoly he ought to have a quick and easy road to their final establishment, and if his rights are ill-founded, the public ought to have prompt benefit. This Tesla case serves to point the moral. Invalidation at this late date means that grievous wrong has been done either the public or the inventor. If a patent is sustained after years of legal strife, the owners of it have small chance to secure adequate damages from infringers who have had ample time to clear up their profits and get out; while if it is broken, the public has paid the piper and has no remedy for years of tribute.

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It would take a very long legal head to devise an adequate remedy for such a state of affairs, but procedure in infringement cases is certainly one of the weakest points in our patent system, and it sorely needs improvement. In general, the remedy lies in rigorous rulings as to laches and the establishment of a definite procedure by which prosecutions for infringement need not, and could not, be bandied about from District to District and from lower court to upper court. As it now goes, the whole procedure is needlessly drawn out from tribunal to tribunal, and the litigants spar for wind month after month and year after year. Infringement cases are, it is true, sometimes complicated and often involve gathering large masses of evidence, but we do not overstate the facts in saying that of the time taken by any of the noted cases, two-thirds has been wilfully and intentionally frittered away by one party or the other in the effort to gain some advantage of position. For all this there is small excuse, and while it is now permitted or at least tolerated, there ought to be provision for throwing a case out of court at the first sign of deliberate negligence, and for compelling both litigants to push ahead vigorously toward a decision. It ought to be possible to force any case to a decision within two years, and that decision ought to carry far more protection than it does at present. In rare instances a very large volume of evidence might require more time than that named, but the whole procedure of taking evidence in patent causes is dilatory and the court ought to have authority to cut it short when abused. Examining a witness for two weeks before an examiner and cross examining him for two weeks more, perhaps on a single claim of a single patent, is little short of a farce, a travesty on the forms of justice, and properly should be interpreted as contempt of court. Patents have, of course, to be put in litigation, but it is little short of scandalous to permit the fight to last through Time into the borders of Eternity.

## Bidwell Electric Railway Patent Litigation.

Judge Cochrane, on February 20, 1903, dismissed a suit of Benson Bidwell, Clara E. Bidwell and Charles F. Bidwell against the Consolidated Street Railway Company, of Grand Rapids, brought in the United States Circuit Court for the Western District of Michigan, and involving claims for damages and profits in connection with alleged infringement of an electric railway patent.

The basis for the suit was patent No. 318,594, dated May 26, 1885, which the Bidwells alleged broadly covered any and all practical means for propelling and lighting cars by electricity supplied from a central station, and lighting the way stations and track as well, the lamps and car motors being supplied with current by a single set of conductors connected with the generating station. The broadest in terms of the claims of this patent is the first, which reads as follows:

"In an electric railway, cars having an electromotor, a line circuit, movable circuit connection between the line circuit and said motors, a branch circuit in said movable circuit, and an electric lamp with switch mechanism in said branch circuit, substantially as shown and described."

The third claim specifies branches for lamps and switches "along the line of way." The patent expired last year.

The Bidwell Trolley & Car Telephone Syndicate, Limited was organized as a "partnership association" November 5, 1902, under "the provisions of Chapter 160 of the Compiled Laws of the State of Michigan of 1897," with an initial capital stock of $3,000,000, having a par value of $100. "The business to be conducted by this association is to collect damages for infringements" of the claims of 7 patents (of which 3 have expired) and 5 applications (of which 2 are stated by the articles of the association to have lapsed); also to collect and receive royalties, etc. The business office of this "Syndicate" is at Grand Rapids, Michigan, and the treasurer for the first year is Benson Bidwell. This suit is only one of a large number that Bidwell has brought under several patents relating to electric railways, which he claims broadly cover devices in universal use. One suit in particular against the Manistee, Filer City & East Lake Railway Company, of Manistee, Mich., relates to Bidwell patent No. 684,596, issued October 15, 1901. Bidwell claims that this patent covers the modern overhead trolley system. His application was in the Patent Office for seventeen years and the patent granted is maintained by the defendants to have claims of very limited scope which bear no relation whatsoever to the trolley system in common use.

The suits instituted by the Bidwells have principally been against the smaller electric railway companies, and though none has been successful, the defense has been vexatious and expensive. There is not the slightest probability at the present stage of electric railway development that paper patents of the Bidwell class will be adjudged by the courts to control the art.

## Telephony Before the Chicago Electrical Association.

S. J. Larned, general superintendent of the Chicago Telephone Company, gave an entertaining paper before the Chicago Electrical Association Friday evening, March 20. The paper was somewhat popular in its nature, but gave the electrical engineers in other lines a good idea as to some of the inside workings of the telephone business in a large city. Mr. Larned began by showing the important place the telephone occupies in our modern civilization. The history of the progress of civilization is principally the history of transportation and communication. Various branches of telephone service were then briefly spoken of, including the growing importance of residence telephones. It is coming to be more and more the case that a man is considered isolated from the world if he cannot be reached by telephone. One of the chief values of the telephone in a residence is in the kitchen; and in San Francisco a very popular one-way party line service has been installed, called the kitchen service, by which a number of transmitters and receivers are put on a party line. The calling is one way, that is, the subscribers can call central, but central cannot call subscriber. This service is primarily for the giving of grocery orders. Residence service has many variable demands put upon it.

The growing importance of the operator in the private branch exchange was noted. The operator in the private branch exchange of a business house performs many of the functions of a private secretary to the leading members of the concern, and is more closely in touch with the whole company's business than is any other one person. In fact, the private branch operator becomes such an important cog in the business machine of any concern that when, after two years' service, when she has become thoroughly familiar with the business, she marries the bookkeeper, there is general grief until her successor can be broken in. The importance of the private branch exchange business is shown by the fact that in New York City there are twice as many private branch exchange operators as there are operators in the regular exchanges. In view of the growing importance of the private branch exchange operator, who gives personal attention to the telephone communication of the various persons connected to her exchange, Mr. Larned thought it unlikely that any mechanical or automatic system would displace the operator, as he thought the tendency was rather toward having an operator who would give personal attention to the telephone business of the concern, than toward an automatic exchange.

The average number of calls per line per day in Chicago is 17 to 18. An average of one call in every five is not given connection because of busy lines. The average length of time taken to complete a connection in Chicago is nine seconds.

## A Lighting Swindle.

A new swindle, it is reported, is being worked on the rural population of northern Ohio. A man, bearing the card of an electric lighting company, supposed to be located in New York City, calls on the farmer. He has a small box bearing on the top a closed lamp with a frosted globe, of the exact appearance of a large size incandescent electric light. The turning of a button serves to light the lamp, which burns brilliantly. The solicitor goes on to tell the farmer that his company is the proprietor of a patent electric light plant, occupying a very small space, and which they will install at the small cost of $2 per light. The lighting of the average sized farm house will cost but little at this rating and the farmer is only too willing to make the purchase. A contract is produced and signed. This is sealed up in an envelope and left with the farmer until another representative shall come and install the plant. A few days later this man appears. The contract is produced and read. To the farmer's surprise and consternation it calls for $64 per light. Of course a refusal to have the plant installed follows, the agent threatens suit, and in order to avoid trouble the matter is compromised by the farmer giving his note for $200 which the agent takes to the nearest town and sells. The light exhibited is an acetylene one and a clever substitution of contracts completes the deception, at which so many are biting, it is said.

## The New Battleships.

The last Congress appropriated the necessary funds with which to build five new battleships. In these electric motors, etc., will be used on an unprecedented scale. Most of the ammunition hoists will be controlled by electricity, while a moving platform passing by the doors of the ammunition rooms, will carry a continuous supply to the lifts, the men in the rooms having only to carry the boxes to the door and to place them on the traveling sidewalk, from which they will be removed as fast as needed at the various hoists for the gun stations. A safety feature of the ships will be the method by which all of the doors in the principal water-tight bulkheads can be controlled from a central emergency station. The doors will be closed automatically by power by the simple pressing of a button.

## Power Rates in New York State.

A bill has been introduced in the New York Assembly to prevent discrimination of rates by electric power companies which derive their power from navigable streams or other bodies of water wholly or partly within this State. It requires a uniform scale of prices, which must be published annually in the newspapers, and forbids rebate, drawbacks or other forms of discrimination in rates. It allows an increase of 5 per cent. where the power is carried from ten to twenty-five miles and of 10 per cent. where it is carried more than twenty-five miles.

## An Example From the Pacific Coast in Running Telephone Cable and Wires.

There is much in Horace Greeley's famous maxim, "Go West, young man." The East stands often for the conservatism which supports and sustains, the West for the radicalism which advances though it sometimes destroys. Even in minor affairs is this tendency clearly portrayed. Who has not often watched with mingled curiosity and contempt the process of installing telephone cables in New York or Chicago streets? At one manhole a huge wooden reel is clumsily jacked up upon a couple of wooden horses and supported on an iron bar thrust through a hole in its center. In the other manhole an old wooden capstan, seemingly a remnant of the equipment of the Ark, is tied to a couple of spikes, driven between the pavement stones. A hemp rope, badly frayed, passes over a pulley to the duct and is attached to the cable. When all is in readiness, some long wooden staves are thrust into the capstan head and a gang of patriarchs, almost as dilapidated in appearance as the apparatus, slowly man the winch, and with many a squeak and groan the cable slowly emerges at the rate of about 10 ft. per minute. Even the street urchin sarcastically whistles, "Tramp, tramp, tramp, the boys are marching," as the veterans toil about the windlass and stumble over the leading rope.

FIG. 1.—CABLE-DRAWING MACHINE.

On the Pacific coast the Home Telephone Company has set a notable example, for there some 10,000 ft. of cable are pulled per day with a gang of seven men, while here a gang of nine rarely make more than 3,000 ft. To begin with, the reel is mounted at the store yard or freight house upon a couple of broad-tired wheels and swiftly rolled or pulled by horse power to the man-hole, where installation is commenced, and instantly dropped into place, as is shown in Fig. 3. At the other end a really modern pulling engine is set. This consists of a substantial iron frame truck, upon which is placed a hoisting machine with differential gearing and two drums. This is driven by means of a 3-hp 500-volt electric motor, controlled by a variable rheostat. One side of the motor is grounded upon the truck, while the other side a heavily insulated flexible cable proceeds to a hook, mounted upon a long wooden handle, that can be instantly attached or detached to a neighboring trolley wire. The wattmeter is included in the cable circuit, so that the amount of energy demanded by the pulling engine is always recorded. This apparatus is shown in Fig. 1. The hemp rope is replaced by a quarter-inch flexible steel strand that is coiled three or four times about one of the drums of the engine, and passes to the hands of an attendant, who thus has the most sensitive conceivable control over the pulling of the cable and can stop its motion within the fraction of an inch. He can, in fact, feel it move and accelerate, retard or stop its motion as the case may demand. That such an electric drive for cable pulling would be severely handicapped by the absence of a trolley wire cannot be gainsaid; but in these days, when half the new bicycles are equipped with gasoline motors, there is little excuse for the capstan of our great-grandfathers.

New York is fortunate in having but few overhead lines, and those that remain are rapidly following the way of all flesh, and disappearing underground, so that Pacific practice in the stringing of open wire line is of minor interest to the Manhattanite, but in other suburban or rural districts, aerial lines will have a long lease of life and Pacific methods, as shown in Fig. 2, may, with profit, be copied. A special iron wagon consisting of a stout channel iron frame, placed upon four broad tired wheels, is provided. There are two longitudinal bars, each of which is equipped with five wrought iron pipe reels, so designed that a coil of hard-drawn copper wire may be dropped onto the reel and unwound without kinking. The cart is hauled to one end of the line, and a pulling rope, a couple of thousand feet in length extended over the cross-arms of the poles. One wire from each reel is mounted in its proper hole in a running board, to which the pulling rope is attached. A horse at the other end of the rope furnishes necessary power and strings ten wires simultaneously, so that some five miles of wire are erected at a single pull. When a coil is exhausted a MacIntire joint splices on a new coil, and the process continues until all the desired wire is in place. Where more than one cross-arm exists a spilt running board is used for the lower arms and wire strung with equal speed.

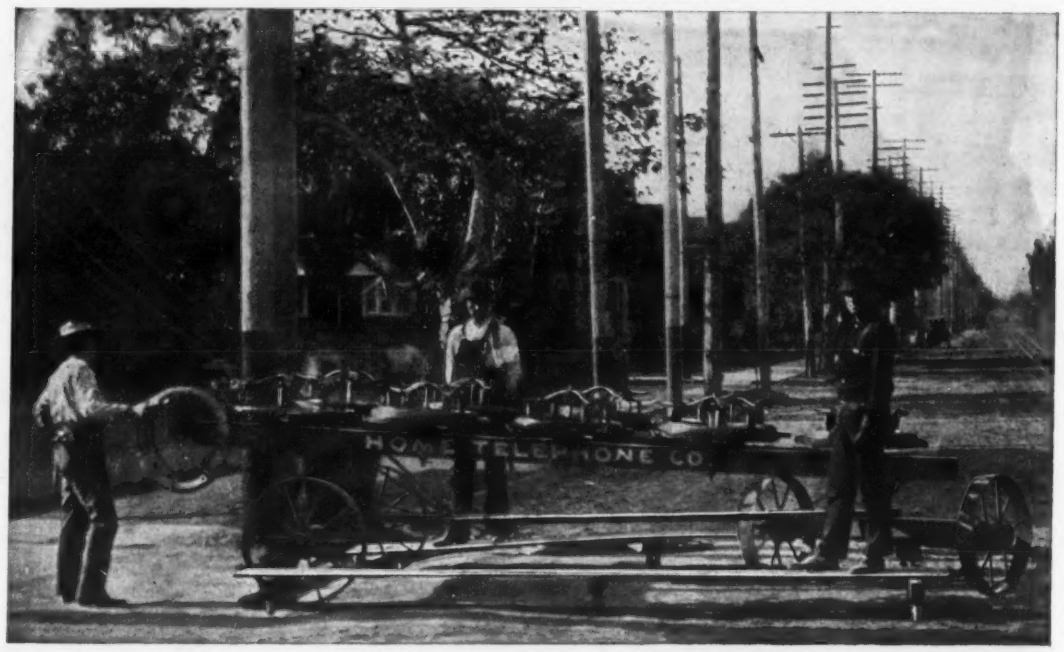



FIG. 2.—APPARATUS FOR STRINGING WIRES.

While the process of installing cable in conduits here described entails an expense for some special apparatus, this should in most cases be recouped many times by the saving in the labor bill.

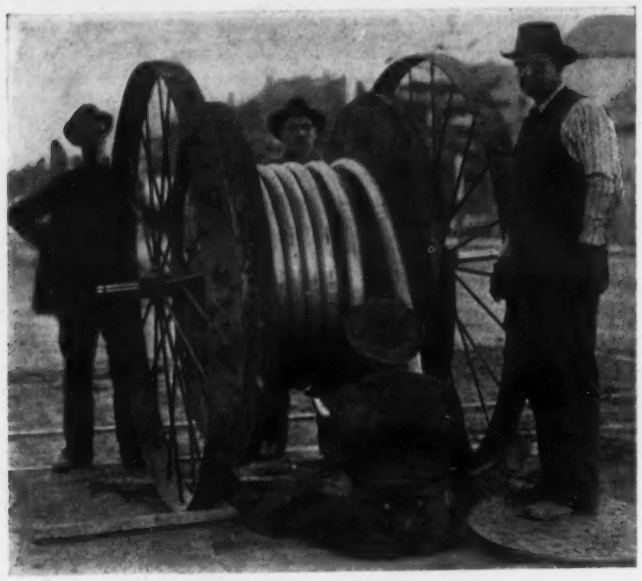


FIG. 3.—REEL MOUNTED ON WHEELS.

As stated before, where dependence cannot be placed on trolley circuits for a supply of power, a gasoline engine could be employed, or a steam engine of the standard portable type mounted on wheels, together with the necessary hauling-in gear.

## Electric Lighting at the Delhi Durbar.

AS if to distract attention from the abject poverty of the masses of India—or perhaps to distract temporarily the attention of these masses from their suffering—the government of that country recently indulged in a most gorgeous ceremonial costing, according to newspaper reports, some millions of pounds. To lend even more than Oriental magnificence to the Durbar, electricity was called into requisition, and a huge temporary generating plant erected, details of which are given below.

Work on the plant was commenced early last year, all material having to be sent to India from England. The site selected was in a rocky jungle, which was cleared for the erection of a boiler house 125 x 38 ft. and an engine house 125 x 28 ft., both being covered in with corrugated iron. Ten 50-hp boilers and two 80-kw and seven 40-kw direct-connected generating sets were installed. Current was generated at 440-480 volts and two three-wire balancers employed. A switchboard 30 ft. in length was erected containing 10 dynamo, 13 feeder and two balancer panels.

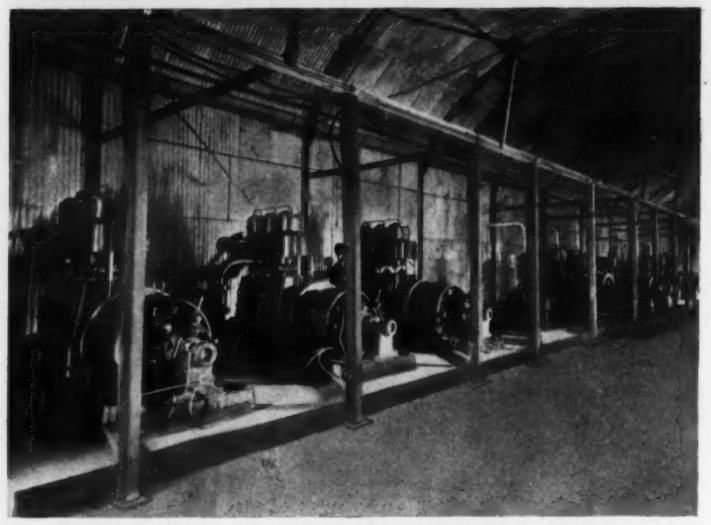


FIG. 1.—GENERATING PLANT.

The feeders were led from the switchboard to two special overhead constructions which carried the wires over the main road, from whence they were divided into the various overhead feeders, each of No. 0 bare copper wire. Over 600 poles of the tube type and 60 miles of No. 0 copper wire were used. The distribution to the tents was by lead-covered wire laid underground from the feeder points to the respective tents, this distribution having a total length of 35 miles. The wiring of the tents was carried out in braided vulcanized rubber cable, of which some 50 miles were used. Ordinary opal shade pendants were used for general illumination and decorative fittings in special tents.

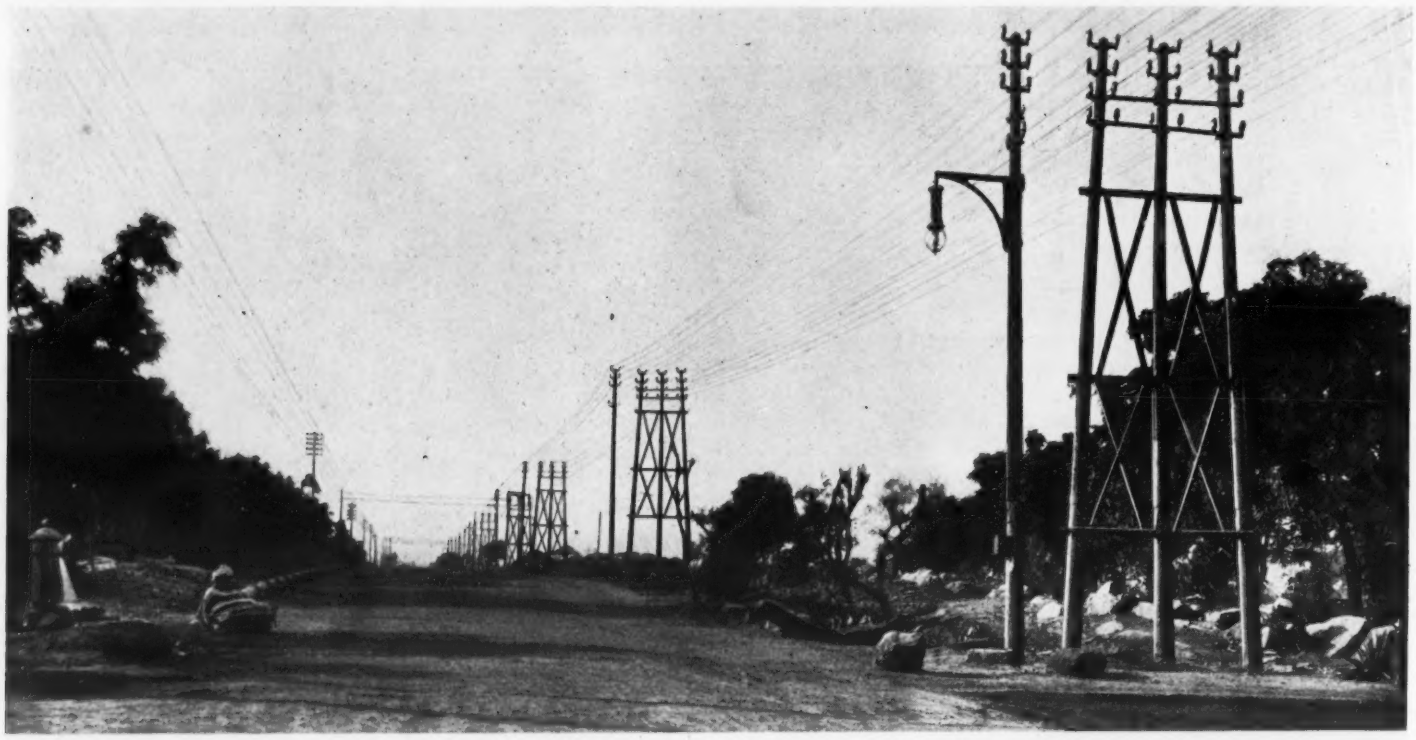


FIG 2.—VIEW OF OVERHEAD WIRE CONSTRUCTION, DELHI DURBAR.

The materials used in the tent wiring consisted of some 15 miles of flexible wire, 5,000 switches and cut-outs, 9,500 incandescent lamps and some 9,500 lampholders, carriers, etc. The street lighting consisted of 100 enclosed arc lamps and 380 incandescent lamps fitted upon the feeder and special poles. The light was switched on to

the camps on December 7, 1902, and discontinued on January 22, 1903. The whole plant ran without a hitch throughout the Durbar, though the entire work was carried out by native labor. The staff engaged upon the works consisted of 38 Europeans and 1,000 natives,

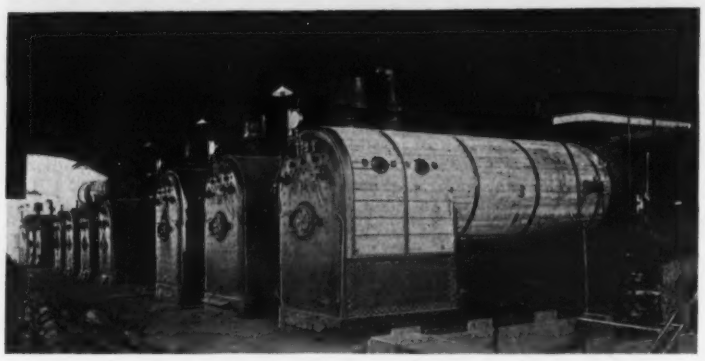


FIG. 3.—BOILER PLANT.

special camps having been built for their accommodation. The plant is now being dismantled and dispatched to the various military cantonments, where it will be re-erected and used for barrack lighting and punkah pulling.

## The Induction Coil.

BY JAMES EDMUND IVES, PH. D.

AN induction coil consists of a primary, secondary, condenser and break. It may be represented graphically as in Fig. 1. In the figure, $L_1$ and $L_2$ are the inductances of the primary and secondary coils respectively; $C_1$ is the capacity of the condenser around the break, and $E$ is the e.m.f. of the primary battery.

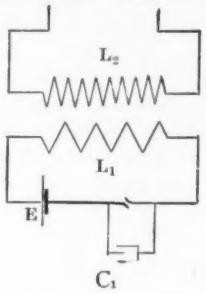



FIG. 1.—COIL CIRCUIT.

To get the greatest difference of potential in the secondary, the condenser must be adjusted so as to stop violent sparking at the break. Under these conditions when the primary circuit is broken, an oscillating current is set up in the primary, the period of which depends upon the inductance of the primary and the capacity of the condenser. This current is represented graphically in Fig. 2.

In the case shown in the figure, the primary current is supposed to be broken slowly, so that there are only a few breaks a second. The point *a* represents the point of time when the circuit is closed. The current then rises to its maximum value at *b;* is broken, and an oscillating current appears which vanishes at *c*. The period of this oscillation is given approximately by

$$T_1 = 2\pi \sqrt{L_1 C_1}. \qquad (1)$$

It will be seen that the condenser around the break makes the primary current oscillatory. The changing current in the primary induces an e.m.f. in the secondary, and by Faraday's law the greater the rate of change, the greater will be the induced e.m.f. The greater the capacity of the condenser around the break, the flatter will be the curve shown in Fig. 2. Therefore, just as little capacity should be put in as possible, just enough to stop violent sparking. At present no law is known which determines this, but Walter and others have shown that if too much capacity is used, the length of the secondary spark is decreased rather than increased.

Lord Rayleigh (see *Philosophical Magazine,* Vol. II, pp. 581-594. 1901) has recently shown by experiment that when the primary circuit is broken very suddenly, as by a pistol shot, the condenser around the break can be dispensed with. In this case the primary circuit is broken so suddenly that there is no time for the potential of the condenser to rise to a sufficient value to cause sparking. This experiment shows that the function of the condenser is to produce as rapid a fall of the primary current, with as little sparking, as possible. Much sparking leads to conduction across the break, and the current cannot then fall rapidly.

The sparking in the primary is, of course, due to the *induced* e.m.f. in the primary, and not to the relatively small e.m.f. of the battery. That capacity of condenser which gives the longest spark in the secondary has been called by Johnson the *optimum capacity.* It depends upon the initial value of the primary current, and also upon the constants of the primary coil; that is, upon its inductance, its resistance and the resistances of the condenser connections. Every coil should, therefore, have a variable condenser. For different currents the condenser must be adjusted so as to give the longest spark in the secondary for that current.

The oscillating current in the primary produces an oscillating difference of potential between the terminals of the secondary, the value of which depends upon the relation between the primary inductance, the secondary inductance, the primary capacity and the secondary capacity. The capacity of the primary circuit is, of course, the capacity of the condenser around the break. The capacity of the secondary is the distributed capacity of the coil due to the fact that the turns of wire lie very close to each other.

Neglecting the damping due to the resistances of the coils, the general equation for this oscillating secondary potential is:

$$V_2 = \frac{I_0 M}{L_2 C_2 - L_1 C_1}\left[\sqrt{L_2 C_2}\ \sin\frac{t}{\sqrt{L_2 C_2}} - \sqrt{L_1 C_1}\sin\frac{t}{\sqrt{L_1 C_1}}\right] \qquad (2)$$

where

$V_2$ = secondary potential,
$I_0$ = initial primary current,
$M$ = mutual inductance of primary and secondary,
$C_2$ = distributed capacity of the secondary;

$L_1$, $L_2$ and $C_1$ have the same significance as in Fig. 1.

It will be seen that it is made up of two component oscillations having the periods

$$T_1 = 2\pi \sqrt{L_1 C_1}, \qquad T_2 = 2\pi \sqrt{L_2 C_2}. \qquad (3)$$

It has been found by experiment that for all coils, even large ones, the secondary distributed capacity is very small, and consequently that the product, $L_2 C_2$, can be neglected. Taking this fact into account (2) becomes

$$V_2 = \frac{I_0 M}{\sqrt{L_1 C_1}}\ \sin\frac{t}{\sqrt{L_1 C_1}} \qquad (4)$$

For a well-constructed coil, we may assume that there is no magnetic leakage; that is, that all the lines of induction through the primary cut the secondary when the primary current is broken. In this case $M = \sqrt{L_1 L_2}$, and equation (4) becomes

$$V_2 = I_0\sqrt{\frac{L_2}{C_1}}\ \sin\frac{t}{\sqrt{L_1 C_1}} \qquad (5)$$

The maximum difference of potential in the secondary, determining the length of the secondary spark, is, therefore, given by

$$V_{2\,max} = I_0\sqrt{\frac{L_2}{C_1}} \qquad (6)$$

The maximum difference of potential generated in the secondary, therefore, depends upon the value of the primary current before it is broken, the inductance of the secondary, and the capacity of the condenser. It varies directly as the initial primary current, as

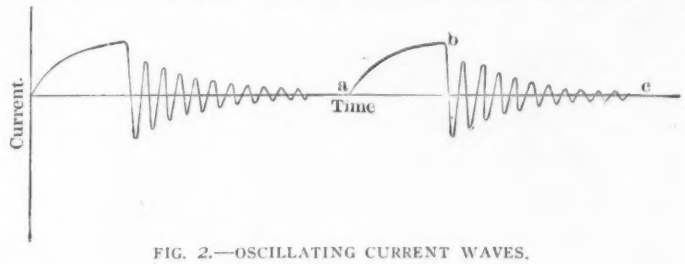



FIG. 2.—OSCILLATING CURRENT WAVES.

the square root of the secondary inductance, and as the square root of the reciprocal of the primary capacity. It is to be observed that it is independent of the primary inductance.

Equation (6) has recently been confirmed by the experiments of Klingelfuss (see *Annalen der Physik,* Bd. 5, pp. 837-871, 1901). His experiments show that for coils giving sparks of all lengths up to 100 cm:

1. The secondary spark length is directly proportional to the number of secondary windings.

2. The primary induced e.m.f. is proportional to the primary current.

3. The secondary induced e.m.f. is also proportional to the primary current.

The maximum difference of potential that can be obtained from any coil can, therefore, be calculated from (6) if $I_0$, $L_2$ and $C_1$ are known.

It is to be noted that theoretically as large a difference of potential as desired can be obtained by decreasing $C_1$. Practically however, this is limited by the sparking. When the break begins to spark violently the secondary potential decreases instead of increasing.

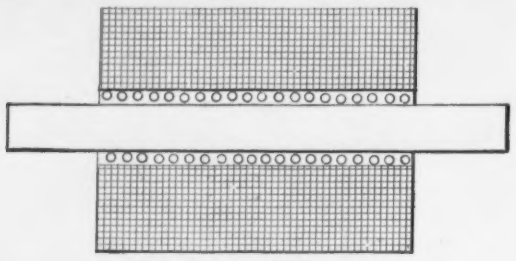


FIG. 3.—STRAIGHT COIL.

Klingelfuss has pointed out the important part which the primary induced e.m.f. plays in the theory of the coil. When the primary current is broken there is, of course, an e.m.f. induced in the primary circuit as well as in the secondary. The maximum value of this primary induced e.m.f. is given by

$$V_{1\max} = I_0 \sqrt{\frac{L_1}{C_1}} \qquad (7)$$

a formula similar to (6).

It is found that for induction coils the formula for the transformer holds approximately, viz.:

$$\frac{V_2}{V_1} = \frac{n_2}{n_1} \qquad (8)$$

Where $n_2$ and $n_1$ are the number of turns in the secondary and primary circuits respectively. Therefore, if the number of turns in the two coils, and the primary induced e.m.f. are known, the secondary e.m.f. can be calculated. $V_1$ can be calculated from (7) if $I_0$, $L_1$ and $C_1$ are known.

The determination of the inductance of a coil having an iron core offers some difficulty, since the primary current is oscillatory, and the permeability varies with the strength of the current. This difficulty may be met by determining the inductance for a small current, and then for the maximum current, and taking the mean.

### THE CONSTANTS OF A COIL.

Walter (see *Annalen der Physik*, Bd. 62, pp. 300-322, 1897) found for a 30-cm coil, a mean value for $L_2$ of 620 henries. With $I_0 = 3.6$ amp and $C_1 = .22$ microfarads he obtained a spark 20 cm long, representing an e.m.f. of 130,000 volts. In the primary circuit he found $I_0 = 3.70$ amp, $L_1 = .122$ henries, and $C_1 = .22$ microfarads. Therefore, $E_1$ was equal to 2,750 volts. For a 60-cm coil he found a mean value for $L_2$ of 9,000 henries.

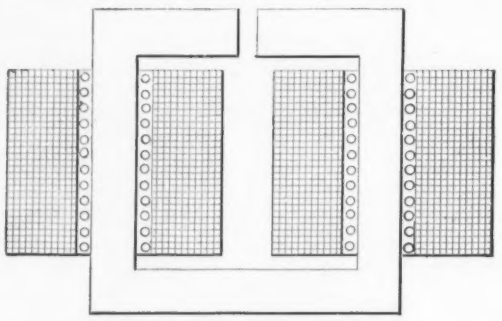


FIG. 4.—HORSESHOE COIL.

Klingelfuss experimented with two types of coils, one the ordinary type of a straight coil, shown diagrammatically in Fig. 3, the other the horseshoe type, shown in Fig. 4.

Varying the number of secondary turns, he obtained the results given in Fig. 5.

Curve I gives the results for the horseshoe type. II, for a straight coil with a core of large cross-section. III, for a straight coil in which the core had a square cross-section, being made of Swedish iron, .05 cm thick. The ratio of the length of a side of the cross-section to the length of the core was 1:20. He found that if a core was used in which the ratio of a side of the cross-section to the length was 1:12, the spark length was increased about 25 per cent. IV gives the results for a Carpentier coil, having a maximum spark length of 45 cm. His experiments were made with a mercury break in which the breaking pole was an amalgamated copper wire, dipped

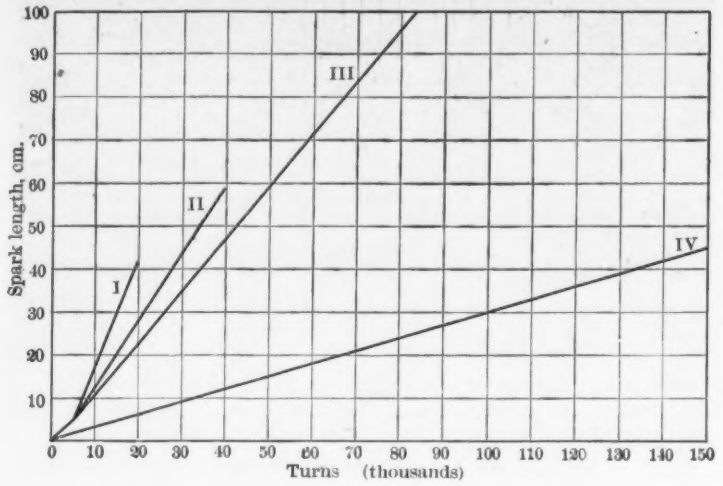



FIG. 5.—RESULTS OF VARYING SECONDARY TURNS.

in and out by hand. The mercury was covered with a layer of petroleum. My own experience has been that this break is the most efficient. The spark length in the secondary was measured between a blunt positive point and a negative plate. The curves in Fig. 5 show:

1. That the horseshoe form is more efficient than the straight form. It cannot, however, be used for high differences of potential, as the sparks jump from the coils to the iron and thence across the air-gap.

2. That the greater the amount of iron in the core, the longer the secondary spark. My own experiments show that as the number of iron wires in the core is increased, the secondary potential rises very rapidly at first, and more slowly afterward (see *Physical Review*, Vol. XIV, Figs. 6-9, 1902). One of these curves is reproduced

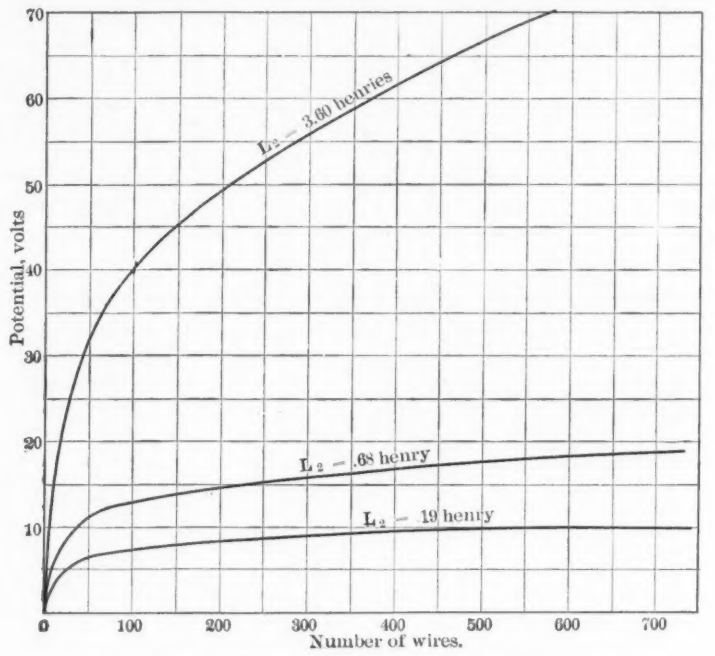



FIG. 6.—CURVES SHOWING EFFECT OF IRON IN CORE.

in Fig. 6. The iron wires were of soft iron 35 cm long and .0830 cm in diameter.

3. That a coil of a relatively small number of turns, when properly constructed, and used to the best advantage, can be made to give very long sparks. He obtained sparks 100 cm long with only about 85,000 turns. To achieve this, the secondary must be well insulated, the most efficient form of break must be used, and the condenser around the break must be variable so that the capacity can be adjusted to

that most suitable. The importance of this last condition is shown by the curves in Fig. 7, taken from a paper by Mizinro, in the *Philosophical Magazine*, Volume 45, 1898.

These curves show how the secondary spark length is increased up to a certain point by increasing the capacity of the condenser, and then is decreased. The peak of the curve gives the "optimum capacity" for a given primary current.

In my paper in the *Physical Review* I have given the dimensions

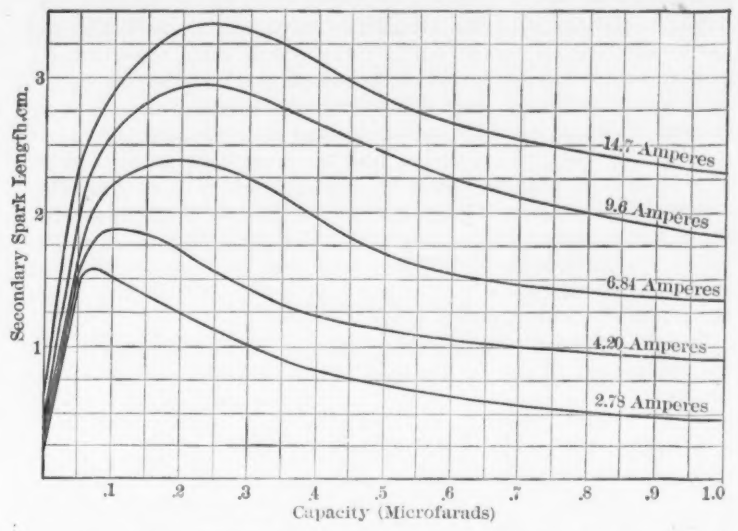



FIG. 7.—EFFECT OF VARYING CAPACITY AROUND THE BREAK.

and corresponding inductances and resistances of a number of secondary coils. The inductances were determined with an air core. These tables are reproduced in Tables I and II below. The coils were wound with No. 34 B. & S. single silk-covered copper wire. Each layer was separated from the next by a strip of thin paper. In Table I each coil is given separately, while in Table II they are taken in groups placed side by side upon the primary. The primary was made of two layers of No. 12 wire and had the following dimensions:

| | |
|---|---|
| Number of turns in outer layer | 109½ |
| Number of turns in inner layer | 109 |
| Total number of turns | 218½ |
| Mean length | 25.63 cm. |
| Diameter of the outer coil | 4.47 cm. |
| Diameter of the inner coil | 4.11 cm. |
| Diameter of the wire | .230 cm. |

Its self-inductance with an air core was .000281 of a henry.

THE CONSTRUCTION OF COILS.

The best form of induction coil appears to be the straight form with a long core projecting three or four inches beyond the secondary. The object of this arrangement is to economize the secondary wire, since the number of lines of force cutting a turn of the secondary is greater at the middle of the primary than it is at the ends. This is illustrated by the curve of Fig. 8, which is taken from my paper in the *Physical Review*. It shows the flux of force through a single turn of the primary coil at different points of its length. The primary used was that of which the dimensions have already been given. Curve 4 was calculated. Curves 1, 2 and 3 were found experimentally.

Various rules have been given for the length of wire needed to produce a spark of required length, such as "a mile of wire to every inch of spark"; but it is evident that such rules mean very little since the secondary difference of potential depends upon the diameter of the secondary wire, the character of the core, and the conditions prevailing at the break. The only way to have definite knowledge about a coil appears to be to measure the inductance of the secondary. Then if the value of the primary current and of the capacity of the condenser around the break is known, the secondary potential can be calculated from equation (6).

TABLE I.

| Mark. | No. of Turns. | Inside diameter in centimeters. | Outside diameter in centimeters. | No. of turns in a layer. | No. of layers. | Self-inductance in Henries. | Mutal inductance with primary in Henries. | Resistance at 21° C in Ohms. |
|---|---|---|---|---|---|---|---|---|
| AI | 5469 | 7.62 | 13.00 | 52-60 | 100 | 3.551 | | 1527.0 |
| AII | 4600 | 7.62 | 13.00 | 50 | 92 | 2.594 | | 1351.7 |
| BI | 5558 | 7.36 | 12.85 | 52-59 | 100 | 3.595 | .00763 | 1516.0 |
| BII | 5000 | 7.36 | 12.49 | 50-57 | 95 | 2.913 | | 1365.0 |
| BIII | 5000 | 7.37 | 12.82 | 50 | 100 | 2.951 | | 1391.3 |
| BIV | 5000 | 7.34 | 12.25 | 51-60 | 90 | 2.934 | | 1425.1 |
| CI | 1250 | 7.39 | 8.88 | 50 | 25 | .1867 | | 297.8 |
| CII | 1250 | 7.36 | 8.85 | 50 | 25 | .1896 | | 298.5 |
| CIII | 1250 | 7.37 | 8.87 | 50 | 25 | .1880 | | 297.5 |
| CIV | 1250 | 7.40 | 8.95 | 50 | 25 | .1893 | | 295.8 |
| DI | 2500 | 7.38 | 10.28 | 50 | 50 | .684 | | 612.2 |

TABLE II.

| Coils used. | Self inductance in Henries. | Mutual inductance with primary in Henries. |
|---|---|---|
| BII+BIII | 9.67 | |
| BII+BIII+BIV | 18.92 | |
| BI+BIV | 11.06 | .0145 |
| BI+BIV+BII | 20.84 | .0213 |
| CI+CII | .5774 | |
| CI+CII+CIII | 1.076 | |
| CI+CII+CIII+CIV | 1.639 | |

## Telephones for the Sick.

Telephones in the sick room, it appears, are not altogether a novelty. The latest instance reported is that of a Wall Street broker who was ill with scarlet fever in the late fall and was quarantined in a private ward of one of the city hospitals. He had a telephone placed at his bedside, and over it transacted all the details of his business during his convalescence, when the danger of contagion is greatest. In less than four weeks, while still a prisoner in his room, he executed deals that netted him more than $16,000, with which he hopes to pay his doctor's bill.

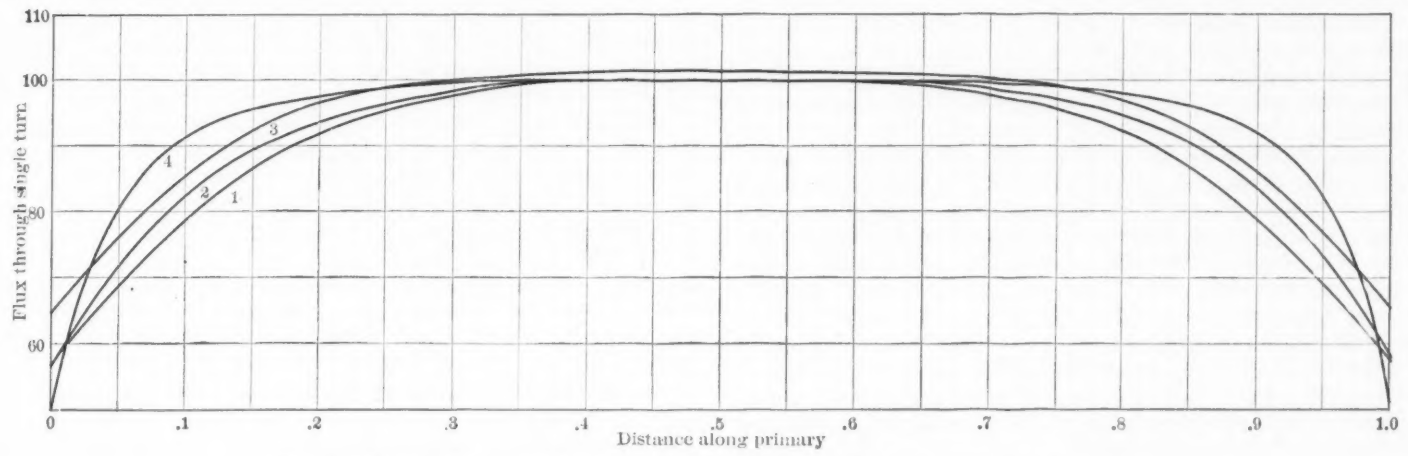



FIG. 8.—CURVES SHOWING FLUX AT VARIOUS DISTANCES ALONG THE PRIMARY COIL.

## Thurston on the Steam Turbine.

At the March meeting of the New York Electrical Society, Prof. R. H. Thurston delivered a lecture entitled "Steam Turbines up to Date," of which we give below an abstract:

Though the beginnings of the steam-turbine are found in the earliest historic times and in the earliest technical literature, its progress is wholly modern and mainly recent. Only after the evolution of the modern physical and mathematical sciences could its action be understood and the machine be properly designed; only after modern tools and methods of mechanical construction had become refined could it be built in safe and economical forms. The influence of the Alexandrian school upon modern engineering is shown to have been mainly through the philosophers who sowed the seeds of which we now see the germination and the fruit. They were necessarily dormant during the nearly two thousand years which elapsed between the days of Greek philosophy and modern, practically applied, science.

The fundamental ideas of the theory of the steam turbine were considered as embodied in the modern steam turbine. The transformation of energy from its thermal into its dynamic form was traced and the principles controlling the thermodynamic change and the limitation of wastes were exemplified, both for the ideal case of the perfect machine and for the practical construction of the day. The method of development of thermal energy was exhibited and the mechanism of the process of change into dynamic form shown.

The turbine is not a thermodynamic machine, but belongs to the same class as the hydraulic turbine and its design, construction and operation are controlled by the same ultimate principles. The radical distinction between the types of the ancient Greek and of the engineer of the seventeenth century was pointed out and the influence of this difference in type upon the practical value of the invention brought out. The limitations controlling the engineer in his design and construction due to this difference in type were explained and their effect upon the economic value of the turbine shown. Notwithstanding these limitations it is found that the turbine is more nearly a "perfect steam engine" than any other known type, so far as its design and construction are concerned. It remains to be seen what the practical outcome is to be.

The economies and the wastes of the steam turbine were discussed and it was found that the machine, if its construction can be made perfect, will operate precisely as would its purely ideal representative. Its preliminary thermodynamic conversion of energy in the formation of its jet within the nozzle is exactly conformatory to the scientific theory of the case, and the action of the turbine itself, receiving the jet, is that which a scientific and perfect construction would illustrate, in so far as energy conversion is concerned, if the apparatus be correctly proportioned and constructed.

It is discovered, on investigation, that the wastes of the turbine, as now illustrating the best work of the time, are apparently not far different in amount from those of the best work on the older type of steam engine, the piston engine, but that these wastes are of a different sort and peculiarly distributed. The problem of their reduction is a radically different one from that of the older engine.

The present status of the turbine as respects design was shown and its relation to the ideal standard of the engineer was examined into. The Hero turbine as used in "centrifugals," the Branca type as employed in the same class of machines, the old Avery and Atwater types, and the recent forms of De Laval and Curtis, Parsons and Rateau, were shown to approach the theoretical ideal more completely than ever has or probably ever can any reciprocating engine. It does not necessarily follow that they will ultimately excel the common type of steam engine in every-day practice; it simply means that to this extent they possess certain fundamental advantages. The fundamental principles of the steam turbine being now entirely familiar to the engineer, its design has become one of the simple problems of construction and may be carried out with perfect comprehension of the requirements of the case as well as of the methods of successfully meeting those demands.

The now familiar types of simple and of compound turbine illustrate the familiarity of the engineer of to-day with this task. He recognized his limitations, as set by the weakness of his materials of construction and by the essential requirements for maximum thermal and mechanical efficiency which make demands upon him which are in precise opposition. He effects the best compromise possible in the one case and endeavors by a modified design to evade those limitations in the other case. Various expedients and various special devices, some of them amounting to real inventions, are found to be more or less successful in effecting this improvement and the differences among the steam turbines of the day are largely of this sort.

The fundamental principles of the compound turbine are simple and all forms of such machines are fundamentally the same in principle.

The performance of the steam turbine of the day, as observed by the lecturer and as shown by the work of many other investigators, was found to be excellent beyond the anticipations of the most sanguine among older practitioners. Figures presented show that the machine is about as economical as other engines of the same power, that its regulation may be made satisfactory and its adaptation to special purposes is remarkably perfect. It is found that while experience is not by any means as complete and judgment, therefore, not so well based as with the more familiar types of engine, the conclusion is probably well justified that this form of steam engine has come to stay and that it will find its field and a broad one in the engineering of the future.

Opportunities for improvement are found, on investigation of the theory and of the performance of the machine, comparing the predictions of a pure theory with the results obtained in a refined practice, to be very large. The direction which these improvements must take is shown clearly by experimental research and the way is clearly visible to all scientific designers and inventors. It is easily shown that there are two, and practically only two, ways of securing further gain in the efficiency of the turbine, the one involving the refinement of the construction of the machine, the other relating to the treatment of the working fluid. The method is simple in its requirements, but the practical meeting of these requirements may involve some difficulties. However that may be, the designers of to-day are competent, well-informed, and have the scientific training needed. They may be expected in due time to attain a high degree of success.

The characteristic advantages of the steam turbine in its now standard forms are, for certain purposes, peculiar and very important. The adaptations of the machine to driving high-speed machinery, to the turning of the armature or the field of the dynamo, to the purposes of the marine engineer, present promising problems. Their solution is already well advanced, in most cases, and we already know that the turbine may be made of use in the operation of machinery, as of alternating-current generators in multiple, where the difficulties with other motors are found to be singular and serious. These advantages are illustrated by the details of the engine trials and of scientifically conducted investigations lately effected.

The- trend of progress and the promise for the immediate future is in the direction of further gain in economy of the machine by suppression of leakage and of friction of fluid within its casing by improved workmanship and by securing a better working substance by freeing it from water and also by utilizing the process of superheating to increase the thermodynamic range. This means, however, improvement at the boiler rather than at the engine; which latter is fitted in all its forms to employ superheated steam of any temperature that can be practically furnished from the steam generator.

The trend of progress at the moment is also toward the application of specially designed and constructed turbines to special uses. It is probable that, gradually, forms will be adapted particularly to use in electric light and power "plants"; others will find employment as marine engines and still others in other varieties of work. The regulation and the adjustment of speeds constitutes a problem, already satisfactorily solved in some cases, but which requires some further consideration in adaptation of satisfactory regulating mechanism to some special forms of turbine and to some special uses.

The promise would seem at the moment to be the introduction very widely of a new type of prime mover which adapts itself in a peculiarly happy manner to purposes for which the common forms of steam engine are not likely to prove as perfectly satisfactory. The indications are that the supply of power by means of this motor will be made as low as with the best types of reciprocating engine and possibly lower; while its simplicity of plan and ease of construction would seem to insure freedom from liability to either accident or depreciation of value to any important extent for long periods of time. The theory and the practical modification of theory in the

design, construction and use of the machine are so well understood and the real so closely approaches the ideal that the engineer may readily see his way toward the solution of any practical problem of design that may be presented, while he also may as readily see a remedy for any observed defect of efficiency or of mechanical action. It should, therefore, be expected that such approximation to the ideal perfect machine as is possible will soon be attained; particularly as, already, the study of the theory and the observation of the practice of the time with this machine is now being made the task of an immense number of learned men of science, of able practitioners and of skillful constructors. Probably never, in the history of engineering, was so simple a machine made the object of investigation of so large a number of able men, inventors, constructors, engineers and men of science, and the subject of such extensive experimental research.

It is very possible that, through the development of this ancient device we may yet see the nearest approximation to ideal thermodynamic and mechanical efficiency in the group of heat motors that man can attain.

## To Discipline Dishonest Electric Companies.

A press dispatch from Albany, N. Y., of March 17, says: There was a hearing to-day before the Senate Finance Committee on Senator McEwan's bill to establish a State electrical laboratory. It provides that the Governor, the State Controller and State Engineer, together with Charles P. Steinmetz and Harold Winthrop Buck, shall be constituted a commission to construct a State electrical laboratory which shall provide for the standardizing and calibrating of electrical meters.

They said that at the present time there was no redress for the man who received less in electrical power than he paid for, outside the courts, and even when he went into court he stood little show of winning his case because of the fact that no impartial board existed in the State to pass upon the facts.

"The necessity for such a laboratory and such inspection in this State," said Mr. Steinmetz, "will be understood and appreciated when I tell you that there is $2,000,000,000 invested in electrical plants and apparatus in this State. The man who buys a pound of sugar knows whether he is being cheated, but such is the limited knowledge which the ordinary person has of electricity that the purchaser of that commodity has to trust to Providence for his due."

In response to many inquiries, we give the full text of the bill below:

The Governor, the State Comptroller, the State Engineer and Surveyor (Edward A. Bond), together with Charles P. Steinmetz and Harold Winthrop Buck, are hereby constituted and appointed a special commission to construct and equip a New York State electrical laboratory with such other duties as are hereinafter designated.

The commissioners shall select and acquire for the people of the State of New York upon such terms as they may approve a site for the location of a State Electrical Laboratory and proceed to construct suitable and proper buildings for the same, according to plans and specifications to be furnished by and under the supervision of the State Architect, and to equip, supply and furnish the same.

For acquiring the site and for the construction and equipment of such State Electrical Laboratory the sum of $275,000 is hereby appropriated, which sum shall be payable by the State Treasurer on the warrant of the Comptroller, out of moneys not otherwise appropriated, on bills audited by the said commissioners, or a majority of them. The said State Electrical Laboratory shall provide for the standardizing and calibrating of electrical meters and other electrical appliances and apparatus and for such independent investigations and experiments in electrical science as will furnish accurate and impartial data for the use and benefit of the people of the State of New York in the settlement of disputes arising from the development and use of electrical power; and for such further researches and experiments as will tend to increase knowledge of electrical power, and its application to serviceable ends.

The commissioners shall appoint a director of said Electrical Laboratory and fix his compensation and term of service. They shall further prepare a plan for management and control of said laboratory when completed, and shall have power to designate and appoint the members of a board of governors whose duty it shall be to direct and supervise the work of said laboratory, selecting and appointing all necessary employees, fixing their compensation and terms of service, prescribing their duties, formulating rules to govern work of the laboratory and determining fees of standardizing and calibrating, including the furnishing of certificates of conformation to the standard and compliance with the rules of the board, which certificate shall be prima facie evidence of the facts therein stated, and for such other work as may be properly subject to charge. All fees received by said laboratory shall be turned over to the State Treasurer to the credit of the general fund.

When completed and in operation, said State Electrical Laboratory shall receive and be open to and for the use of students in electrical science in any university, college or technical school which is or has been incorporated with the University of the State of New York under such rules and regulations as may from time to time be made by the board of governors of said laboratory, or by the director under their authority.

## The Principles of a New Method of Electric Lighting.

BY PAUL HOHO.

THE principal sources of electric light at present in practical use or in an experimental stage are as follows:

1. The voltaic arc.

2. The incandescence of solid bodies, due to the heat disengaged in accordance with Joule's law by the passage of an electric current. This class includes the carbon filament incandescent lamp, the more recent Nernst lamp with a glower having for a base an alkaline earth oxide, and finally, lamps with filaments of a metal or metal oxide impregnated with silicon or one of the rare earth metals.

3. The incandescence of rare gases, also due to the heat disengaged by the passage of an electric current. This method of obtaining light, the principle of which was long ago applied in the Geissler tube, has lately taken on a practical aspect.

The object of this article is to bring forward a new method of electric lighting which does not come in any of the above classes. I may at once say that this method has, at least for the present, no practical application, but it appears to be sufficiently interesting from a scientific point of view to be described, and I shall endeavor to point out what may be the future of the method, and in what manner it may be practically applied.

In the past I have had occasion at different times to refer to a heat and light phenomenon which occurs under certain conditions upon the passage of an electric current through the surface of contact of a solid and a liquid, and, in general, at the surface of contact between a good and a bad conductor. In a paper * which I presented before the Belgian Royal Academy (3rd Series, tome XXV, No. 2, 1893), it was shown that by means of this phenomenon temperatures may be attained higher than have yet been realized by any other method. The two final conclusions of this paper are as follows:

"1. By means of the phenomenon considered, temperatures may be attained incomparably higher than has heretofore been possible with any other method of producing heat; in principle the quantity of heat disengaged per second at a given surface is unlimited, and finally the only limit to the temperature that may be practically obtained is set by the output capacity of electrical generators.

"2. At the surface of contact between the electrode and the electrolyte there is an electrolytic action united with an extremely intense calorific action of such a nature as, under certain conditions, to effect powerfully chemical action."

In the production of heat, it should be borne in mind that the luminous rays are heat rays and that the proportion of light rays to the total number of heat rays—that is, the luminous efficiency—varies, first, with the nature of the body emitting the rays, and second, with the temperature of this body. Since the above-mentioned phenomenon gives rise to temperature higher than can otherwise be attained, it also involves the production of light with an efficiency higher than by any other method.

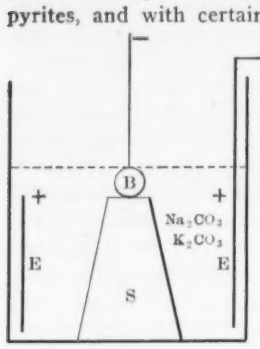
This is true in principle and there remain to be found a means of practical application. Metals can instantaneously be brought to the highest temperatures and fused, but the fusing temperature of

* M. Eug. Lagrange collaborated in the preparation of this paper.

the more refractory metals, such for example as platinum, is considerably less than the temperature of the incandescent lamp carbon filament and that of the voltaic arc. If carbon be submitted to the above-mentioned action of electric current in a liquid, it is in a very short time brought to a white heat with an intense glare; and some of our experiments have appeared to indicate that carbon, though considered infusible, has actually been fused by this process.

It is evident that the temperature of the carbon filament of the incandescent lamp can be carried to a much higher temperature than the normal by simply raising the voltage of the lamp. The delicate thread cannot, however, stand any considerable increase above the normal, whereas there is nothing to prevent carrying to the highest point the temperature of a rod of carbon plunged in water. Unfortunately, the part thus heated is that which is in contact with the water, and a mechanical phenomenon occurs which I have never been able to prevent, no matter what kind of carbon was employed; namely, the tearing off of fine particles of carbon, which discolor the water. We cannot thus hope to produce light in this particular manner.

I next experimented with other materials of infusible character, and notably with the metallic oxides and salts, more especially with silicon. While most of these substances are very bad conductors, there are a few exceptions, for example, the bioxide of manganese. When this latter is employed as negative electrode, it is immediately fused, and at the same time a certain chemical action occurs. The bioxide is reduced to metallic manganese, which falls to the bottom of the receptacle in the form of drops, or being reduced to a less degree than the original oxide, $Mn_2O_3$ and $Mn_3O_4$ are formed. The same reactions are produced with other oxides and with sulphur compounds, such as the oxides of iron and the pyrites, and with certain salts; but the point of fusibility of these metals is too low. It is necessary to have an infusible body or one melting at a very high temperature and which is also a good conductor, in order to produce light by its incandescence in a solid state, or at least by its incandescence in a liquid state.



HEAT CELL.

While I do not know of any oxide or salt which fulfills these conditions, and especially one refractory to heat, while at the same time a good conductor, I have tried to make artificially such a conductor. There are two methods by which this may be done. The first consists in mixing a refractory with a conducting substance, and wetting the resulting body by simply plunging it in the liquid of the bath. Should this substance be somewhat porous, it will absorb a certain quantity of the liquid, which is itself a conductor, and thereby increase its conductivity, which augments with the porosity of the body. If the substance is absolutely non-porous, a certain amount of the conducting liquid will remain on the surface to prime it.

The second method is one which has been employed in connection with lamps of the earth-alkaline oxide type. While the conductivity of metals diminishes as the temperature increases, the opposite is true of these oxides and their salts. Their conductivity increases in a very large ratio with the temperature, and many of these substances which show no conductivity at an ordinary temperature, become conductive when the temperature is raised even slightly.

For example, ordinary glass, with a base of soda and lime, has at 20° a specific resistance of 91 mega-megohms, and this is reduced to 0.705 mega-megohms at 60°. Quartz shows no conductivity below 40°, while at 46° the specific resistance becomes 6,182 mega-megohms and at 105° falls to 11.6 mega-megohms. I may add that all fused substances are conductors of electricity.

By a rational and judicious combination of the means whereby a refractory body can be made more or less conductive, a practical result may be attained. The reactions that take place are, however, extremely complex and somewhat as follows:

To start with, there is a *double* calorific action of the electrical current. First there is the action in the gaseous envelope which separates the liquid from the solid; and as the solid has a high specific electrical resistance, an amount of heat is produced which can become very considerable.

To the calorific action must be added the chemical reactions of the elements which compose the body and of the conducting liquid. All these act together and the intensity of the chemical reactions are strongly aided by the simultaneous action of the phenomena of electrolysis. These reactions evidently vary indefinitely, according to the composition of the substances acted upon. To illustrate I shall describe an experiment with a small sphere composed of a mixture of silica and silicates, notably of aluminum, which gives a mixture more or less homogeneous. The conductive liquid consists of a five per cent. solution of carbonate of soda and bicarbonate of potassium. The exterior conductor to the sphere is an iron wire.

Following are the successive operations: The small sphere *B* composed of a mixture of silicon dioxide and of silicates rests on a support, *S*, so as to be submerged about three-quarters in the electrolyte, composed of bicarbonate of soda and bicarbonate of potassium. The negative side of the electric circuit is brought to the sphere by means of an iron wire. The positive side is connected with the electrode, *E*.

If the circuit is closed, the electrolyte entering the pores imparts a sufficient conductivity to give rise to a slight luminous phenomenon at the surface of the sphere. This, however, soon ceases on account of the water evaporating from the sphere, which must then be remoistened. This luminous phenomenon develops slowly. Simultaneously, two other reactions intervene. The luminosity is a manifestation of a calorific action which at first slight increases slowly and progressively the temperature of the sphere, which in turn increases its conductivity. There is also a chemical reaction. The potassium and the sodium freed by the electrolytic action coming in contact with the silica and the silicates, enter into chemical combination with these as soon as a definite temperature is reached. Small particles of silicate of potassium and sodium in a state of fusion are then formed. These bring about a greater calorification, which augments the conductivity and therefore increase all the preceding phenomena, especially the production of heat.

On the other hand, the iron also enters into combination with the oxide of silica and the silicates and forms a silicate of iron, also in a state of fusion. This can be easily recognized by its dark greenish color.

All of these phenomena take place simultaneously and assist each other, forming finally on the sphere a conductive layer, composed of various mixtures of silicate, especially alkaline silicates, silicates of iron and, of course, silicates of aluminum and silica dioxide. The current will then continue to pass with an even strength for several hours.

The current thus produces a *double calorification,* first at the contact with the water and through the conductive envelope, and secondly by the direct passage of the current in the fused matter.

As for the chemical reactions, I have indicated the theoretical ones, but aside from these others manifest themselves, and, among these there is one of considerable importance.

I consider it certain that the silicon is freed and that consequently a light is produced by the metallic silicon in an incandescent state. I have tried unsuccessfully to distinguish the rays of silicon in the spectrum of this light, but it must be remembered that the rays of silicon are extremely weak.

Under like conditions I have experimented with marble, which has given me similar results. While the chemical reactions are different, their effect is practically the same, but in this case it is possible to distinguish the calcium spectrum.

I shall now make two statements to which I attach great importance:

1. It is evident that the electrical current is in the necessary condition to bring about electrolytic action, that is to say, to decompose the salts and the oxides. Nevertheless, this must not be taken to mean that the entire current produces this action. It may be that part of the current passing produces merely a calorific action without an electrolytic action.

To illustrate, a small sphere weighing about four grammes was for almost five hours subjected to a nearly constant current of 6 amp. If the current had all gone to decompose the silicate of alumina, there would have been produced a quantity $5 \times 6$ multiplied by the weight of alumina deposited per amp-hour (.337 grammes), or $5 \times 6 \times 0.337 = 10$ grains of aluminum. In point of fact, in that time the sphere lost only one-half gramme of its weight. From this I conclude either that only a part of the current exerts an electrolytic action, or that the elements which are separated ultimately recombine, and a continuous cycle of dissociation and successive recombinations takes place.

2. After a certain time an equilibrium is established. The water

assumes a definite level and the current a definite strength, which depends on the diameter of the sphere, on the e.m.f. and on the rate at which the water is supplied. These elements, therefore, give us the means of regulating at will the strength of current and the intensity of light. I have succeeded in causing a small sphere of this kind to glow for six hours with a current nearly perfectly constant.

3. The homogeneousness of the sphere plays a very important part. The sphere may have strata of more or less conductivity. If the mass is not perfectly homogeneous the small luminous manifestations which precede the priming may appear on one or the other side of the sphere, which cannot happen when it is perfectly homogeneous. In this case the luminous manifestations spread all around the iron electrode.

Precisely the same thing takes place in the case of the carbon arc, according as the carbon rod is of perfectly homogeneous composition or not. For proper results it is necessary to have the small sphere as nearly homogeneous as possible. The material of the experimental sphere was far from being of pure quality, and in construction lacked the care that might be given.

I have said that for this method of lighting no practical claims can at present be put forward. The material used offers an inconvenience in that the evaporation of the water gives rise to alkaline vapors which form noxious fumes, and these condensing on the reflector required to thrown down the light, tarnish it, and thus render it useless for that purpose. It is not, however, absolutely necessary to use alkaline salts or even any salt at all. With appropriate substances nothing should prevent the use, as an electrolyte, of salts which do not evaporate, or even of acids. The problem set is, therefore, as follows:

The combination of a luminous substance with an electrolyte and negative electrode, such that a surface-conducting layer will be formed which will not melt or at least only melt at a very high temperature. The question thus becomes merely a chemical one. Moreover, there is nothing to prevent the utilization of the rays of the decomposed elements, such as silicon and calcium.

I have shown that it is possible to obtain experimentally with a constant current a light of constant intensity. There only remains to clear the theoretical process of the imperfections inherent in all new systems.

## The Coming Iowa Electrical Association Convention.

The Iowa Electrical Association will hold its regular annual convention at Davenport, April 8 and 9. The following programme has been arranged for: Wednesday morning, April 8, will be given to routine business. Reports of secretary, treasurer, Executive Committee, etc. Wednesday afternoon at 2 o'clock, will be given the report of a committee on "Electric Street Lighting Data," by W. S. Porter, of Eldora. "Proposed Legislation Relating to the Development of Plans for the Inspection of Wiring," will be the subject of a committee report by J. S. Bellamy, of Knoxville. The report of the committee to establish "A Uniform Method for Arriving at the Cost of Furnishing Electric Current" and to collect forms in use by the different companies, will be given by Isaac B. Smith, chairman, Cedar Rapids. A paper on the "Maintenance and Operation of Central Stations Operated by Steam Power" will be given by H. T. Fiske, of Muscatine. A paper on the "Maintenance and Operation of Central Stations by Water Power" is to be presented by George S. Carson, of Iowa City.

At 4 P. M. a trip by special electric car will be made to the Rock Island arsenal, and from there the party will go to Rock Island and Moline, visiting the power plant at the latter place.

Wednesday evening at 8 o'clock there will be a lecture, either by W. D. Ryan, on "Modern Illumination," or by Mr. Hine, of Chicago, on "Arc Lighting in General." The papers and reports for Thursday, April 9, beginning at 9.30 A. M., are as follows: Report of committee on "Feed Water Heaters," J. A. Innis, of Cedar Grove. Report of committee on "Data for City Pumping by Central Stations," D. F. McGee, Red Oak. Report of committee on "Lamp Testing," J. S. Carson, Iowa City. Paper on "Commercial Rates, Including Fan and Power Rates," L. L. Kellog, Sioux City. Paper, "Analysis of the Cost of Street Lighting," Austin Burt, Cedar Rapids. Paper, the "Necessity for Grounding Secondary Circuits," W. J. Greene, Cedar Rapids.

After this will follow the executive session, election of officers and adjournment.

## The Inventor and the Trust.*

BY WILLIAM STANLEY.

THE relationship of the industrial trusts to the public is receiving the attention of many able men at the present time. The old question of safeguarding the weaker and unorganized side from the possible misuse of power, obtained by the trusts through the control of the producing capacity of the country, is a cause for grave anxiety to economists; and public and personal attention is justly concentrated upon the probable economic results that may follow the trust-born conditions.

The question finally assumes this form: Will the general production of trust-made products eventually give the public cheaper and better manufactures, or will this new system of operating industries result in unhealthy restrictions to general trade and in prejudicial monopolistic conditions? While this question is of paramount importance, far exceeding in its scope the minor field of which I write, yet I think that a statement of the methods adopted by some of these new organizations in dealing with one of the fundamental causes of their existence, may throw a side light upon their general trend and purpose, and may enable us to prophesy their future lines of action.

Next to the national wealth of this country, I believe our national growth, strength and prosperity is due to the American inventor. I by no means wish to sing his personal praises, nor do I desire to compare his individual importance with that of other highly-trained men devoted to other professions, or to the arts, but I believe that there is more national capital, more reserved strength and more potential good to come in this purely American type of man than in any other type that we have as yet developed. It is not necessary here to analyze his qualities, or to synthetically rebuild him, but it may be stated that he possesses in no common degree, foresight and the courage of his convictions, imagery and imagination, confidence and capacity, and an almost unique ability to discern the fitness of conditions to harmoniously operate together.

If to-day invention were stifled, there would remain, it is true, engineering and scientific industry, and progress would be made undoubtedly in the expansion and development of the arts; but one of the great potential forces of the twentieth century would be lost, and a nation not unsimilar in its general characteristics to the Japanese, would inevitably follow.

I believe the present methods adopted by the industrial trusts in dealing with the inventor, his work, his aims, and rewards, will, if uncontrolled in the future, annul his usefulness, discourage his endeavors, disgust him with surrounding conditions, and finally remove hm from the land. Inventors follow more or less definite lines of work. A man may be proficient and fertile in mechanical invention, and unfamiliar with the chemical arts; he may show great ability in solving electrical problems and know little of the possibilities of improvement in separating metals from their ores. He frequently is tied to a definite art by personal peculiarities, local conditions, education, etc. He is, therefore, dependent upon his art, his peculiar line of work, for his reward; and, if this art is in the hands of unscrupulous or narrow-minded men, who control it, he is in a sad way.

The industrial trusts now regularly employ, on salaries or by retainers, bureaus known as boards of patent control. To these boards is entrusted the problem of controlling the arts, by means of patents. They are expected to purchase such patents as they deem expedient, to manufacture any others they think necessary, to gather up "fresh lines of patents" wherewith to assail competitors, to bring suits against infringers, real or imaginary, and generally to operate an offensive patent campaign against competition.

No more pernicious system of controlling trade has ever been devised, and none that is in reality as fatal to the value of honest patents, whether they be owned by the trusts or their competitors. To speak plainly, these patent bureaus pursue an organized effort to obtain illegal support from the United States courts. They, too, often endeavor to restrict trade by means of dishonest patents, obtained in various ways from the patent office, for the specific purpose of controlling an art long disclosed to the public, and consequently free.

The trust patent bureaus are occupied in litigation directed against their competitors. They endeavor to weaken competition by ex-

* Reprinted from *Springfield Republican*, where the communication appeared as a letter to the editor.

hausting the resources of their opponents in costly legal proceedings, prosecutions brought under questionable patents, and sustained by expert witnesses, who are simply the salaried testifiers of the trusts.

I cannot too strongly state those matters, nor, in a brief article, can I clearly describe all of the complex legal methods that are brought to bear upon their opponents by the trusts, but I may give one or two typical examples of the methods employed first, to control an art, and second, to discourage an inventor.

A few years ago an important advance was made in a well-known art. The invention employed new and specialized machinery, and the application of newly discovered data and facts. Shortly after the inventor had successfully completed his working system, he demonstrated it before a number of trust officials, plainly describing its operation and pointing out its far-reaching possibilities. "The trust" proceeded as follows: First their attorneys drew up a patent specification, cleverly disguised as a "blanket patent" to cover the art on broad lines, and then sent it by special messenger to Europe to find an inventor to sign it. After a little preliminary work the messenger returned with the document duly executed. The papers were then delivered to a second trusted attorney, who was instructed "to get it through the patent office." The patent office was presumably honest, but of course ignorant of the true condition, and in a very short time granted the patent.

Here then was a patent that cost the trust a few thousand dollars signed, sealed and delivered upon which the trust proceeded to issue new stock to the amount of several million dollars, a patent that on its face was genuine, but in reality was the grossest fraud.

To keep the real inventor from making trouble the trust allowed him a small pittance, kept spies about him, copied his private papers, bribed his servants, spoke of him as untrustworthy, irresponsible, and generally cast stones at him; but in this case justice to the public, at least, was done. The United States Circuit Court on the first hearing brought under the fraudulent patent disqualified it, although in entire ignorance of its real history.

We may well consider whether this was an attempt to restrain trade, and whether such attempts are likely to stimulate invention by holding out suitable rewards to inventors.

One more example will illustrate a less heroic and more common trust trick. The *United States Patent Gazette* suddenly discloses the issue of a patent covering an important invention in an art. The trust attorneys see it, obtain copies of the patent from Washington, and decide to have it. The inventor is looked up and an offer to purchase his invention is made, coupled with some statement to the effect that one of the trust's inventors had worked out the same result some years before. Now, unless the inventor sells the patent then and there, he may be subjected to the following coercion: First, notice is served on him by the United States Patent Office that (although this patent was issued to him) an interference had been declared between his patent and a new application. Testimony is then taken as to dates of invention claimed by both parties. In all probability the real inventor proves his priority, and the contending application is dismissed; but—and here the important part comes in—the trust lawyers are now in possession of the inventor's sworn dates of invention, back of which he cannot go. Another application signed by another applicant is put into interference with him. Again the dates of invention are given, and the inventor now realizes that he has a hard fight for his patent on his hands. Testimony is taken (the trust does not appear in the matter, of course) and the interference drags along, sometimes for years. Occasionally the inventor is visited by the trust representatives, and suggestions that he sell out are given him in a roundabout way. In 99 out of 100 cases he sells for a trifle and finds himself impoverished and unknown.

Thus I have endeavored to give one or two examples of the trust practices in respect to patents at the present time. What these practices trend to, where they will lead in the future, what their effect will be on the growth of the arts, it is difficult now to foresee. It would appear that the trusts must either have honest, conservative management, or that they must be controlled by the firm hand of the law.

Already a wholesome movement is on hand: The engineers look askance upon the salaried experts who pack the cards for the trust lawyers, and I think the courts view their testimony with suspicion. The lawyers who conduct these litigations for the trusts do not impress one as overscrupulous; they lack the sincerity, the free-handedness, the genuineness that goes with fair dealing, and a sense of justice in their cause; and as a matter of statistics, they far more frequently lose than win their cases. Generally speaking, right does prevail, but it is purchased often by great sacrifice and sometimes by financial ruin.

I am of the opinion that many of the present evils arising from the misuse of patent control may be avoided: First by limiting the number of patents granted to those who clearly disclose invention, and by refusing the great majority of applications for so-called tributary, or subsidiary improvements, for these applications rarely disclose any new idea and are usually based upon the particular application of well-known engineering or scientific data. That is to say they attempt to control the application of engineering methods to a particular subject. Great numbers of these "supporting" patents are taken out by corporations in the name of their engineers, for the reason that each patent obtained serves as a basis for expensive litigation against competitors. Thus in one branch of a particular industry I remember that not long ago 40 separate suits were brought against an alleged infringer who in reality was entitled to manufacture his apparatus by reason of the legal expiration of the master patents covering the fundamental discovery in the art. Therefore, I unhesitatingly state that the patent office should limit its patent rights to the applications that disclose invention, and refuse those based on engineering equivalents or engineering skill.

Second, I believe that our system of patent litigation is responsible for the troubled conditions that now perplex the courts. Under the existing system of litigation the court never or rarely sees or hears the expert witnesses, and, therefore, cannot judge of their truthfulness or character. All expert testimony is taken before a stenographer or typewriter who is nominally an officer of the court, but in reality has no power to enforce the ordinary rules governing the taking of testimony, has no power to limit the length and cost of examinations or to confine the witnesses to the subject matter at issue; consequently the strongest, that is, the richest party may completely exhaust its opponent by direct or cross-examinations of great length (a most expensive element in patent litigation), and thus, in fact, tire him out.

I believe that testimony should only be given by qualified experts satisfactory to the court, who instead of being the accomplices of the lawyers employing them, should, in fact, be court advisers; men capable of fairly advising the court as to the facts and fundamental data at issue. Such testimony should be given before the court, and not its deputy. It should be controlled by the court, and be limited to a terse and clear statement of the principal facts, and not be allowed to generally roam around on unimportant outlying subjects.

Third, I believe that the laws applicable to a conspiracy to injure an individual or a business by unnecessary litigation should be strictly enforced, and possibly modified so as to control the coercion measures now too commonly employed by trusts. These laws should plainly apply to those cases where the trust, relying on the absence of individual responsibility of its officers, used its power to coerce an individual. "Sell us your patents or we will clean you out of business by legal expenses," said the head of a patent bureau to one of my friends a few years ago. "No," said he, "I'll fight." "Well, then fight if you choose, but remember I warned you."

Individually this gentleman was an honest, conscientious, fair-minded man; as the mouthpiece of his trust he was a roaring lion, but as yet he has roared in vain.

In considering the broad question of trust control we must, however, remember that many of these enterprises are still in the hands of their original promoters; that this is a promoting generation which is absolutely certain to pass away when the clarifying effect of less prosperous times appears. We must remember that the men dictating trust policies are of a very temporary type in general uneducated in the true, broad sense. They are men who are primarily anxious to place their securities on a sufficiently remunerative basis to attract the public as purchasers. It is to be hoped that they will be replaced by better educated, broader-minded and cleaner men, who if they do not venture on as daring financial voyages, will discourage the tricky methods now in vogue for coercing competition and restraining trade.

## Marconi's Transatlantic Work.

According to a London dispatch, Mr. Marconi has stated in an interview that he is not prepared to accept any newspaper challenge to demonstrate transatlantic wireless telegraphy, but is ready to demonstrate, before any proper tribunal, his claim that wireless messages can be sent across the Atlantic.

# The Construction of Aerial Telephone Lines—VII.

BY ARTHUR V. ABBOTT, C. E.

## ROUTES AND RIGHTS OF WAY.

THE selection of a pole line route is a difficult matter, because a wise choice of the best route depends far more upon the exercise of judgment, and the experience of a long education in pole line construction, than upon the application of any specific set of rules or formulæ. There are two general principles which must never be lost sight of. These are that the shortest line and the straightest line is the best line. The selection of routes for city lines is governed by the location of the subscribers that it is desired to reach, and by the streets, alleys, or other thoroughfares along which rights of way can be obtained. A city line is best located by plotting upon a good map, showing all available streets and alleys, the location of the subscribers, and then reaching the various groups by such routes as will give the straightest and shortest lines. A large number of Western cities have long blocks which are split centrally by alleys. These are hardly thoroughfares in the true sense of the word, as they are rarely wide enough to allow passage of two vehicles abreast, but they serve as means for the delivery of goods to both dwellings and stores, and afford an additional access for light and air. There is usually little objection to the erection of pole lines in alleys, so where such opportunities exist the designer has comparatively an easy task to select the most favorable wire route, compatible with urban topography. In older and Eastern cities, alleyways are less frequent, and, of necessity, lines must be located along the traveled thoroughfares. It is rare to find a city so hilly that any special designing is needed to accommodate pole lines to vertical changes in alignment, so that this question may be dismissed from the consideration of city pole lines.

The selection of a proper route for a cross country line is in some respects easier, and in others more difficult than the choice of a city route. While in general aerial lines follow the highways, there is always the chance of cutting across private property and thereby either saving distance or avoiding ugly and dangerous corners, and from this aspect the choice of the country line requires more consideration, and a more careful examination of a proposed route, than is necessary in a city. In the location of city lines the obstacles presented by forests or the crossing of wide streams are seldom encountered, but country lines frequently meet these, each one of which must be dealt with according to the circumstances presented. In rural districts the line must necessarily follow the contour of the country, and must be built "up hill and down dale," accommodating itself the best it may to surface configuration. For this reason it is customary to proportion the height of poles to meet, as far as possible, the requirements of hilly territory by using the shortest poles on the summits and the longest poles in the valleys.

*Rights of Way.*—In both city and country lines questions of rights of way play an important part in the selection of pole line routes. In many States the courts have held that the erection of a pole carrying telephone wire imposes an additional burden upon the highways, and that, therefore, telephone companies cannot condemn right of way under eminent domain laws, but must purchase, or otherwise obtain leave to erect poles, specifically from each abutter. Municipal franchises have been construed from a similar point of view. Further, most telephone companies have found it on the whole to their interest to resort entirely to pacific measures to obtain necessary consent for the erection of lines, rather than to appeal to the courts. Partially, this is due to a fear on the part of telephone companies, that if the right of eminent domain (where legal) is exercised, appraising jurors will establish such a measure of damages for the occupancy of either highway or private property, as to set a dangerous and undesirable precedent, which, if established, would incite all property owners to make an equal charge for every pole—thus, on the whole, raising the cost of construction above that which now obtains even when burdened by such damages as are occasionally demanded by miserly owners.

It is to the last degree desirable that questions of right of way should be fully and thoroughly settled prior to the commencement of work. If this is not done, the pole line gang, as it proceeds, is hindered and delayed, and the cost of erection enormously increased by objections which are sure to be interposed by property owners who feel that their just rights are being unwarrantably invaded. Again, it is relatively an easy matter to secure the right of pole erection, or tree trimming from an owner if approached by a polite and tactful right of way agent. If construction is commenced in the absence of a definite and well-understood agreement, the owner is likely to be raised to such a pitch of, what appears to him, warrantable indignation as to render it impractical to subsequently secure any consents whatsoever, and a resort to the courts, or a change in location, is the only remedy. Moreover, it is very greatly to the interest of the telephone company owning a pole line to secure the "good will," cordial friendship and assistance of all persons along the line of its routes. It must be remembered that the wire plant is an exceedingly exposed structure, that the poles or circuits may be injured, or even destroyed maliciously with the greatest facility in such a manner as absolutely safe against detection.

There is no pole line that is always exempt from accident, and when the day of disaster arrives, the hearty co-operation of all abutters is of the greatest value as an aid towards the repair of the wreck, remission of possible claims for damages due to falling poles and wires, and, if a subscriber, a greater tolerance of impaired service. To quarrel with an abutter, on anything short of overbearing injustice on his part, is in the end folly. So by throwing away a few sprats, the telephone company is likely to catch a great many herrings. Fair and square business dealings, the prompt and honorable fulfillment of all obligations on the part of the telephone company, with a manifest endeavor to be a little more than just to the property owners, are sure to win out in the long run.

In securing rights of way there is nothing more important than an explicit and definite contract with each property owner, stating exactly where and how poles and guy stubs shall be set, and to what extent tree trimming is permitted. For each location the right of way agent should secure a sketch, which may be conveniently made in a manifold copy book. This sketch should show the location of all poles and guy stubs with reference to the property lines of the owner. A brief contract should be drawn, specifying the number and location of poles and guy stubs, for which permission is given as shown upon the sketch; finally, the contract should contain a clause stating specifically the trees for which trimming permission is given, and how much trimming is to be allowed.

All such contracts should be made in duplicate on regular form (of which the following is a model), one copy to be retained by the company, and the other given to the owner. Occasionally property owners are met with who will grant right of way, but will not sign any contracts. In negotiating for right of way, therefore, it is always desirable to make a party of two men, so that there are at least two witnesses to every transaction.

In securing rights of way the right of way agent should plainly and honestly explain to each property owner exactly what the telephone company proposes to do, so that subsequently there may be no misunderstanding in the instructions given to the foreman for the erection of the line. When construction is actually undertaken, the foreman must be supplied with a copy of each contract, and instructed to be particularly careful that all poles and guy stubs planted are entirely within the specified height, diameter and location recorded in the contract with each owner; and ordered to take the utmost pains that tree trimming is done in such a manner as to injure in the least possible degree all trees or shrubberies; and that, under no circumstances, without additional special permission in writing, should tree trimming exceed that specified in the contract. It is only by means of dealings which are perfectly honorable and above board, and in which the telephone company is clearly within the rights that it has secured prior to commencement of work, that it is possible to establish any tolerable *modus vivendi* with property owners along the lines of open wire routes.

While all legal questions of importance should be referred to counsel, general managers and superintendents can gather valuable information, and inform themselves in a general way, as to right of way questions, by consulting Keasbey, on "Electric Wires"; Croswell, on "The Law Relating to Electric Wires," or Joyce, on "The Law of Electricity."

### RIGHT OF WAY CONTRACT.

(Form ——.)

The.....Telephone Company.

In consideration of the building by the.....

Telephone Company, of a telephone line from..... .....to .....to be located.....
.....
.....
And the further consideration of.....
the receipt of which is hereby acknowledged well and truly paid to, and received by..... .....,
the undersigned, do hereby agree both for....., jointly and singly, and for.....heirs, assigns, and legal representatives, jointly and singly, to permit the said Telephone Company, and its assigns, to erect and perpetually maintain the following specified poles, guys, guy stubs, and attachments; and also to cut, trim, or remove the following specified trees and shrubbery, as may be necessary to permit of the free and unobstructed passage of all the wires, cables and other attachments that said poles may now, or in the future, carry. And.....agree said trimming may be repeated from time to time in the future, whenever the growth of said trees or shrubbery may render it necessary.

If said telephone line is not completed within.....years from the above date, or if in the future said company, or its assigns shall abandon its line, or shall discontinue the use thereof for a period of one year or more, then this contract shall be null and void, and all rights thereunder shall revert back to.....or.....
heirs, assigns, or legal representatives.

In witness whereof.....hand.....are affixed this.....day of.....

Witness.....
.....
.....
.....

THE ADVISABLE CAPACITY OF POLE LINES.

Opinion as to the desirable capacity of open wire lines varies greatly. Formerly lines of twenty or even thirty cross arms have been constructed, but such lines are now only matters of history. In general, two-pin, four-pin, six-pin and ten-pin cross arms are recognized as standard sizes for arm design. Occasionally twelve-pin arms are used, but these are too rare to be standard, and when no more than four wires are needed, brackets are commonly employed. The two-pin cross arm is used where but a single circuit is needed, but is usually employed for lighting or power circuits. Four, six and ten-pin arms are used for a corresponding number of circuits. The tendency now seems to lie in the direction of the substitution first of aerial cable, and then of underground construction when any considerable number of circuits are needed. The best practice inclines to the design of a 35-foot line, carrying three or four cross arms. As soon as these are filled, a 50-pair aerial cable should be erected and the circuits transferred to the cable, thus releasing the open wire and permitting it to do duty over again. As soon as the 50-pair cable is full a 100-pair cable should be placed upon the other side of the poles. When this 100-pair cable is exhausted, the line is carrying 180 wires, and at this point, or even before, underground construction is to be recommended as more economical.

## The Electric Club of Pittsburg, Pa.

The first annual report of the Electric Club of Pittsburg, Pa., is issued in the form of an attractive booklet under date of March 19, 1903, the anniversary of the club's organization. This pamphlet, of artistic design and illustration, gives the constitution and membership of the club, the scope, plans and personnel of the various committees, and an outline of the work accomplished and proposed. A feature of this work which has proven very valuable is the formation of classes for the study of technical subjects under the instruction of various engineers of the Westinghouse Electric & Manufacturing Company. These classes, or "sections," constitute "self-exciting" engineering societies within the parent body, each section pursuing a separate and definite line of study.

As a further aid, there is a well-equipped technical library, including the various electrical and mechanical magazines. The social side of life is directed by the committees in charge, of which not the least is that known as the "Ladies' Committee"—an ever-to-be-desired element in any club. The club has proved a decided success.

## A Plea for the Skyscraper.

In addressing the Nineteenth Century Club recently on the subject of "Skyscrapers and their Consequences," Mr. Reginald Pelham Bolton, M. E., dealt with some of the æsthetical and general denunciations to which the tall buildings have been subjected, and presented the relatively superior importance of the mechanical engineering features of the tall office building and hotel, with some of the following considerations:

The tall building is no longer an experiment, but a fixed element in the existence of the metropolis, in which it has special source for existence and increase. The whole island of Manhattan comprises but 19.65 square miles, in which the old form of two-story building has so far disappeared that there are but 524 classed in that humble category.

It is an illustration of the actual need of height—merely as a means of increase of the area available for the populace, that if the present residents in tenements, flats, apartment and apartment hotels, who aggregate over 1,700,000, were to be afforded a separate home at an average of 6 to each small dwelling they would cover an area exceeding the entire area of the island by 12,576 acres, without allowance for parks, avenues, streets, docks, railways or business buildings of any sort.

The particular justification of the so-called "skyscraper" has been and is in the congested business district forming the extremity of the island, but also forming the center of the metropolis. This area comprises but 960 acres in all, including streets and the city park, and the erection of tall buildings has actually added a floor area of 179 acres, or nearly one-fifth to the total, this addition being placed in the positions where most required and making it possible to conduct various businesses by an increasingly large number of persons occupied therein, in a much more convenient and rapid manner than is the case in other cities where the members of a trade or profession are widely scattered. The result has been to bring more business firms to New York, and to promote the vast accumulation of its business and trade. These being the motive forces by which the tall building has been required, it is useless for æsthetical, artistical and architectural critics to waste their energies in denunciation and protest against the lofty structures when these are justified in their location. And incidentally it must be also said that those criticisms do not appear to be unanimous nor to be shared by the general public, since it is evident that the great offices have a special attraction to visitors and form one of the objects of sightseers of all tastes and nationalities. That they are in many cases crude, overbearing and lamentable failures in appearance is only repeating what architects generally admit, but the art of their outside design (their proportions being an element of circumstance and location and not influenced by the designer) has advanced with a better understanding by the professional designers, particularly in the direction of avoiding that superfluity of petty decoration which is so dear to the heart of that large proportion of architects who insist in regarding themselves as artists. In effect the nearer the designer has come to the realization of the fact that decorative treatment of such structures as chimney stacks, bridge towers, engine frames and business machines or skyscrapers, is out of place, and therefore, out of art, the more appropriate has the outside appearance of the building been.

It is too patent to need remark that the elements in which the tenants of such buildings are concerned are all interior and are mainly of a mechanical or engineering nature.

Given a sufficient access of air and light, in the possession of which the owners of these properties may be left to fight their own battles, the special questions in the exterior appearance and proportions of these vast buildings, in which the public has a vital interest, are the depreciation of the public streets of light and air, by the crowding together of such structures, the misuse of public property such as stoop areas and vault privileges under sidewalks, the disfigurement caused by lofty dead walls and their possible nuisance in future advertising, and the disproportionate demand created by the addition of the height of the buildings for the public convenience of water. On these subjects much may be written and said, and in them the public has rights which have been hitherto ignored. The tall buildings only exist by the use of some of these public conveniences, and should be made to bear their due proportion of the original cost and existing value.

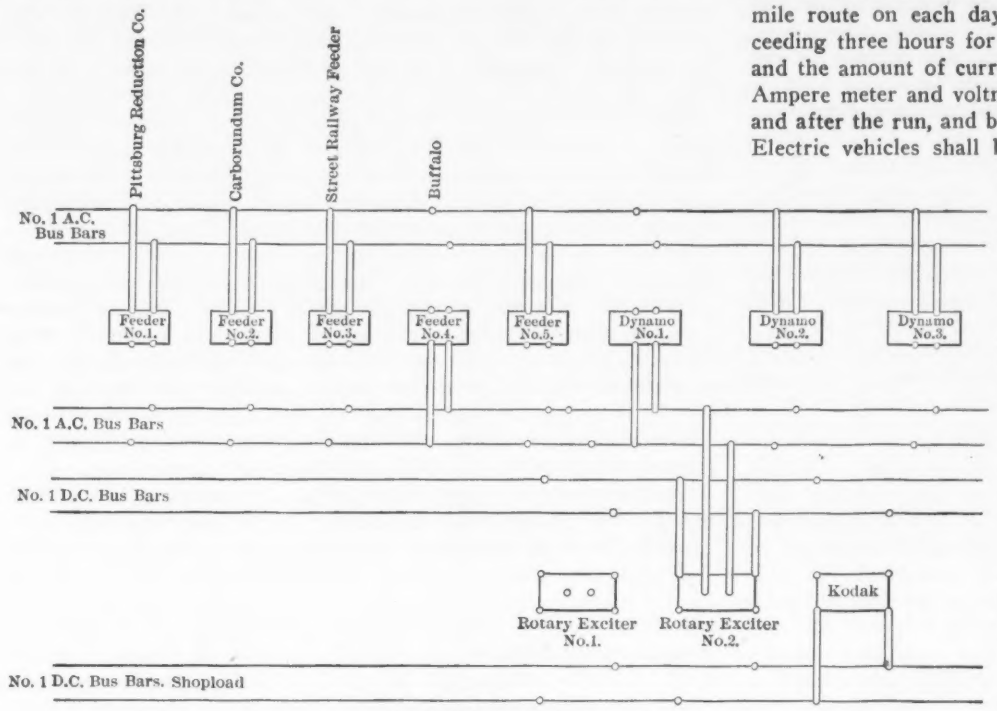
## A Switchboard Model.

BY ARTHUR B. WEEKS.

Soon after the first three generators with their five-feeder switches were put in operation at the Niagara Falls power house it was early made manifest that any method which would reduce accidents due to switching to a minimum, would be of great value. The accompanying diagram is that of a model devised by one of the electricians for his use when in charge of the switchboard.

Whenever a generator, feeder or exciter was changed from one bus-bar to another, he changed the small wires on the model accordingly, so that he always had a working model before him. Since the several switches here mentioned are all beneath the slate floor of the switchboard, there is nothing but the position of the short levers on the panels on the platform to indicate what bus-bars they are on.

The rotary exciters shown have connections both on the alternating and direct-current bus-bars. This is due to the fact that they




SWITCHBOARD MODEL.

are driven by alternating current, and deliver direct current to bus-bars for field excitation.

The "Kodak" is a direct-connected, direct-current unit, used to start up the plant after a shut down. As four turbine-driven exciters have been added to the plant since, the "Kodak" is now seldom used.

One who has watched the growth of the Niagara Falls power plant knows that all of the 5,000-hp feeders here shown are used to supply the long distance lines.

## Trials of Commercial Automobiles in New York City.

The Automobile Club of America has issued the following prospectus for the commercial vehicle contest which the club will hold on May 20 and 21:

*General Conditions.*—The Automobile Club of America will hold on May 20 and 21 a contest for commercial vehicles which will be open to all types of self-propelled vehicles used for commercial purposes, made in the United States or abroad.

*Observers.*—There shall be an observer on every vehicle.

*Stops.*—The contest shall cover two days. On the first day vehicles in all classes shall cover the route without stops, except those that are involuntary. On the second day they shall cover the route, making various specified stops, according to their classes.

*Route.*—The route shall be twenty miles long consisting of a run from the club house at Fifth Avenue and Fifty-eighth Street to the Battery at the foot of Broadway; from the Battery up town and through the northern part of the city and back to the club house. Vehicles in all classes to go twice over this route (40 miles) on each day of the contest.

*Load.*—Each contestant shall furnish his own dead load, consisting of whatever material he may see fit to carry, which shall be weighed and checked by the Contest Committee. The committee will provide at the starting station a certain amount of ballast, in convenient form, to be available to supply any deficiencies in contestants' loads.

*Tare.*—Contestants will be required to report to the committee's representatives at the weighing station on the day before the contest with their vehicles empty, so that they may be weighed in that condition, and again (with their dead load on board) on the morning of each day of the contest, to be weighed and checked by the committee.

*Cost of Operation.*—The amount of gasoline, electricity, coal, etc., consumed (which shall be furnished by contestants) will be measured and the cost of operation per ton mile ascertained.

*Electric Vehicles.*—There shall be a class for electric vehicles. All electric vehicles shall be required to go twice over the twenty-mile route on each day. They shall be allowed one stop not exceeding three hours for re-charging batteries, the time of such stop and the amount of current taken to be recorded against the vehicle. Ampere meter and voltmeter readings will be taken each day before and after the run, and before and after all intermediate re-chargings. Electric vehicles shall be subdivided into four classes as follows: First Class—To carry a dead load of 750 pounds. (To make 100 specified stops on second day's run.) Second Class—To carry a dead load of 2,000 pounds. (To make 100 specified stops on second day's run.) Third Class—To carry a dead load of 3,500 pounds. (To make 20 specified stops on second day's run.) Fourth Class—To carry a dead load of 10,000 pounds. (To make 10 specified stops on second day's run.) Each vehicle must carry a dead load of at least 75 per cent. of its own weight in addition to the driver and observer.

AWARDS.

Medals will be awarded, based on economy in cost of operation and time consumed in covering the cost within the legal limit of eight miles per hour, as follows:

750-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

2,000-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

3,500-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

10,000-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

Certificates will also be awarded, stating the performance of the vehicle.

## Automobile Exposition at Brussels.

Consul Roosevelt reports from Brussels that an international exposition of automobiles and motor cycles was held February 7 to 16 in the Cinquantenaire Park, at Brussels. The hall was partly illuminated by electricity. There were 150 exhibits. One solidly constructed truck, which was immediately bought for the Congo Free State, had a carrying capacity of 6 tons and hauling capacity of 6 additional tons; average speed per hour, 12 kilometers (7.45 miles). The consumption, either alcohol or petroleum, was 1 liter (1.05 quarts) for 3 kilometers (1.86 miles), and its capacity permitted a run of over 90 miles without refilling.

## Autobiography of Mr. Charles Proteus Steinmetz.

Mr. Herbert Wallace contributes to the March number of *Success* a well-written and extremely interesting account of an interview with Mr. Charles Proteus Steinmetz. The first portion of the article contains expressions of opinion on the various electrical problems of the day which are admirable in their lucidity and in the firm grasp of the various subjects to which they refer. We reprint below the autobiographical section of the article:

"I was born April 9, 1865, in Breslau, Germany," he said; "I did not go to school until I was seven years old, when my father sent me to the best one available. He was always interested in scientific subjects, and I think it must have been from him that I acquired my interest along those lines. For twelve years I attended the gymnasium, as the school is called there. Then I went to the university, in the same city. As a boy at home, I had a small chemical laboratory, and used to spend a good deal of time in it, but I joined in all the sports and amusements of the time. In the gymnasium I was always interested in mathematics. It happened, during the last year there, that the professor gave additional lectures, which I attended. These lectures helped me a great deal, and, when I entered the university, I was in advance of the regular class. I want to say that absolutely all the success I have had has been due to my thorough study of mathematics.

"I went to the university to study mathematics and astronomy. It was somewhat before the time of electrical engineering. The arc and incandescent lamps did not exist, except, perhaps, as curiosities. Then I became interested in physical science, and studied physics, and, later on, natural history. It was some time before I began the study of electrical engineering, and then, strangely enough, it was chiefly because of my friendship for a fellow student who was pursuing that subject. When I commenced, I had no thought of making any practical application of it; I merely wanted to know something about the subject.

"My father had a fairly good government position, but he was not able to supply me with an unlimited amount of money. He had sufficient income so that I knew I could always live at home. The result was that I did not hurry through the university, but studied for five years there. I wanted to be independent, however, and so I undertook tutoring in mathematics. I had a practical monopoly of the business of preparing deficient gymnasium students for graduation, due to my knowledge of the needs of the university courses, and the peculiarities of the professors, and so I could pick the men I wanted to tutor. The work gave me a small income, enough to carry me along.

"I was twenty years old when I met my electrical engineer friend. It was through him, also, that I became connected with the Social Democratic party. We used to meet in different rooms and discuss Social Democracy. We talked of revolutionizing the world without any consideration of feasibility, just as young men are likely to do; but, for all that, it was very interesting. It really did me a great deal of good, though now, you see, I have somewhat reformed. I began to learn more about men, and studied workingmen, their ways of living, etc. I wanted to know how they look at things. Of course, all this socialistic business was secret. It happened that the editor of the Socialist paper there was suspected and imprisoned, and, without the knowledge of my father, I became editor of the paper. There was quite a band of us, and, to divert the police, we got a Polish fish-vender to be recorded as the responsible editor. The fish-vender could not read or write, but we arranged to give him, as compensation, the left-over copies of the paper.

"For several months, while I was a student, I was the editor of three publications—the weekly Socialist paper, a weekly issue of *Popular Science Leaflets*, and the *Popular Science Fortnightly*. Part of the time, however, the latter two papers did not appear, because of difficulties with the printer and the paper dealer. None of the writers for any of the publications was paid for his work, and I never received a cent for mine. It was done for the good of the cause and for amusement.

"Finally, the police confiscated the Socialist paper. They arrested the supposed editor, the Polish herring man, and wrote out a statement for him to sign, but he could not write his own name. He and several others, among them my electrical engineer friend, were thrown into prison, and the government officials were sure they had all the leaders, and that the movement had been effectually broken up. Shortly afterwards we reorganized the paper and went on as before. Few of the real leaders had been discovered.

"We found a very ingenious way to communicate with the prisoners. A friend of mine, who was imprisoned with the rest, was, at the time, preparing his graduation thesis. He was allowed to send out to me for some literature on the subject. Among other things he asked for was matter about a certain electrical constant. Instead of the customary denotation of the constant (the Greek letter K), he wrote the chemical formula, NaCl. I at once noticed this, and guessed that he had written something on the paper in salt; so I dipped the paper in a silver solution, and was enabled to read his letter to me. We were then allowed to send him some solutions to use in cleaning his teeth. I also managed to send him in some blotting paper which had previously been dipped in some chemical. I would then write him a letter in this chemical and he would dip it in the tooth wash and develop it. In this manner we corresponded regularly, and by this means my friend was enabled to send and receive love letters to and from his *fiancée*. The correspondence was absolutely reliable, and was never detected. We were kpt informed of what was going on in the prison, and, when the police examined outside witnesses, we were enabled so to coach them that the same evidence was brought out as had been produced by examination within the prison.

"Then came an important turning-point in my career. We had grown bolder, and had sent a delegate to the Socialistic Congress in Switzerland. The police began to suspect and to watch my movements. They first tried to drive me out of the university by preferring charges against me to the president. They failed in this, and then I learned that they were about to arrest me. I decided to visit a theological friend who lived on the Austrian border, and wrote him a post card so that the police might see it. As soon as I arrived at my friend's home, I slipped across the Austrian border. I hurried to Vienna, and then made my way into Switzerland. The proceedings against me were continued on the court records for several years, but nothing was ever done, and the action was finally dropped for lack of evidence. The name of my friend is still seen frequently in foreign scientific publications.

"At the time of my flight from Germany, I was engaged in writing my thesis, a mathematical subject—very complex—afterwards published in Germany. I had saved some money for the publication of the thesis, but most of this went for traveling expenses. I did not have much when I arrived at Zurich, but I rented a room, paid the rent for a month in advance, and then gathered my friends there for a dinner to celebrate my escape. The next day I found I had just enough supplies to last me two days. I had previously written a book on 'Astronomy,' and had arranged to put it into the hands of a small but responsible publishing house. So I wrote to the publishers for money, and they agreed to give me thirty-seven francs (about seven dollars and thirty cents) a month. That was quite a lot of money for a student. Then I happened to meet one of the big lights in the Democratic party, a senator. He was one of the owners of a political paper, and, through him, I secured a commission to write a series of articles on popular astronomy for the paper. I received two dollars for each article, and one was used every two or three weeks.

"Before I left Germany I had intended to become a chemist. Because I was a Socialist, I could not bring myself to accept a government position, and I could not have earned a living at mathematics except in a government position. Electrical engineering really did not then amount to anything in Germany, and chemistry seemed the only field in which I could make a good living. When I reached Switzerland, however, I decided to take up mechanical engineering. I knew much about a good many things, but nothing by which I could make a living. Obviously, my political career was ended.

"I had arrived in Zurich in June, 1888. I studied privately during the summer, and in the fall entered the Polytechnic School with an elective course made up of mechanical engineering, turbine, steam engine, bridge construction, designing, etc. A friend and I lived together, and cooked our own meals. The following year my friend's guardian directed him to go to America, and I decided to go with him.

"We sailed in the steerage on a French liner, paying seventy-five francs from Zurich to New York. I have crossed the ocean since, in the first cabin, but I have not had so pleasant a voyage since as was that one in the steerage.

"I could read Latin and Greek readily, and started to learn English on the ship. I carried with me two letters of introduction from the editor of the *Electrotechnische Zeitschrift,* and a commission to write a series of letters from America for that paper. Through one of the letters I succeeded, finally, in getting a position.

"When we landed in this country my friend and I went to Brooklyn, N. Y., to live. Day after day we tramped about the great city, looking for work. One of my letters of introduction was addressed to Mr. Eickemeyer, who had a small electrical plant in Yonkers. I went to see him, and he promised to write to me later, about a place, but he probably forgot about me, and I did not hear from him. Then I went to see him again and he told me to report the following Monday, and begin as a draughtsman, at a salary of twelve dollars a week. My friend also succeeded in getting a place, and we took up our former housekeeping plan together, in a room in New York City. I had to get up very early, prepare breakfast and go to Yonkers.

"Our plan worked very well, with but one drawback. We could never agree as to who should wash the dishes. We were both good cooks and managed to live cheaply and well, but, after a year of this life, my friend had his *fiancée* come from Germany, and they were married. Then I moved to Yonkers, to be nearer my work."

From a draughtsman at twelve dollars a week, able to speak English very imperfectly, Mr. Steinmetz has become, as I have already stated, one of the greatest of electrical engineers, a consulting expert to whom other engineers are accustomed to go for solutions of difficult problems.

"How did I come to be graduated from draughting?" he asked, in reply to a question. "Well, it was a very simple thing. One day Mr. Eickemeyer happened to come into the room where we were working, and he was in a great rage because he had stained his fingers with aniline ink and could not get it off. I told him to use a certain acid, diluted, and the ink would come off at once. The result was as I said, and he was so pleased that afterwards he invited me into his office, and we gradually became acquainted. I was able to be of some assistance to him, so he raised my salary and kept me working more with him. He put me in charge of all new and experimental work, and I had to look after the men, make patent drawings, and see that everything was properly done at the factory. I studied every night until after midnight, and, during the first two or three years there I wrote a number of scientific papers."

It was not long before the leaders in electrical manufactures saw the advantages of combination, and scores of such factories as the Eickemeyer plant joined to make one of the greatest electrical companies in the world. Each one of these smaller plants had, of necessity, its expert man, and, naturally enough, the combined concern needed a chief of experts. The man was ready, a man who knew, and thus the hard-working, hard-studying engineer and inventor, Steinmetz, came into his own.

## Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

### SILOXICON.

"Siloxicon" is a term destined to become as familiar to the commercial world as "Carborundum." It is the name of a new compound, or class of compounds, discovered by Mr. Acheson, consisting of carbon, silicon and oxygen in chemical combination, and possessing physical and chemical properties of great importance to the metallurgical arts.

Siloxicon is described in Mr. Acheson's patents, assigned to the Acheson Company, of Niagara Falls, as amorphous grey-green when cold and light yellow when heated to 300° F., or above; very refractory to heat, insoluble in molten iron, neutral toward basic and acid slags; indifferent to all acids save hydrofluoric; unattacked by hot alkaline solutions; and self-binding to such degree that the use of a separate binding agent is not essential in forming it into crucibles, furnace linings, fire-bricks, and such other articles as may with advantage be made from it. The articles may be formed by merely moistening the pulverulent material with water, molding and firing, or a carbonaceous or other binding agent may be used if desired. As suggested uses for the new material the inventor names refractory linings for furnaces or converters; crucibles, fire-bricks, muffles, tuyeres, etc., and the properties of the body as above detailed sufficiently demonstrate its peculiar value for these purposes. A crucible composed of a material which is insoluble in molten iron, unattacked by its slag, and unaffected by furnace gases, possesses qualities which are scarcely to be found combined in any substance heretofore in the hands of metallurgists; add to these the self-binding character which permits the construction of the crucible without the introduction of any extraneous matter, and the material becomes unique.

Siloxicon is a product of the partial reduction of silica by carbon, and has been prepared by Mr. Acheson in an electric furnace of the resistance type, but under regulated temperature conditions. The charge used may vary in composition, but a mixture of two parts of silica with one part of carbon is given as suitable, sawdust being added if desired to increase the porosity of a fine mixture and its carbon content being considered in the preparation of the charge. The temperature of formation of siloxicon is less than that required for the production of carborundum, as at or about the temperature of formation of the latter compound, siloxicon is decomposed, and passes in part into carborundum, much in the same manner as carborundum, at a still higher temperature, passes into graphite.

### A NEW REDUCING AGENT.

The lower chloride of titanium, titanous chloride, $Ti Cl_3$, is known in solution as a powerful reducing agent, and in crystalline form, with eight molecules of water, as an unstable salt of green color, dissolving to opalescent solutions. Mr. Howard Spence, of Manchester, England, now prepares the salt by electrolysis, by cathodic reduction of the corresponding titanic compound in a diaphragmed cell, and subsequent evaporation of the solution under reduced atmospheric pressure. The crystalline salt so obtained is described as of a fine lilac shade when dried, tending toward violet when damp, very stable, and readily soluble to a clear liquid. As a reducing agent it is stronger than stannous chloride, and should find a wide application in the arts.

### SUBDIVIDING BLOCKS OF CARBIDE.

The rotating furnaces used by the Union Carbide Company, at Niagara Falls, for the production of calcium carbide yield their product in the form of great masses or ingots, which in practice are broken up while still in the furnace. The method whereby this is accomplished forms the subject of recent patents to Joseph Scales, assigned to the company, and consists essentially in aiding the drill by means of a re-agent capable of locally disintegrating the block; a cavity or a series of cavities is thus formed through which the block is broken. The invention is a broad one, limited neither to a specific material to be broken nor to a particular re-agent for disintegrating it. As applied to the carbide work, however, it consists in injecting into the cavity formed by a drill, preferably through the drill itself, air, steam or water, which oxidizes and disintegrates the heated block; through a series of cavities so formed the block may be broken as desired. The cavities may even be formed without the use of a drill by means of a jet or jets of the re-agent.

## New Telephone Patents.

Since the advent of the central energy telephone system, contact relays have received an attention and development unprecedented. They have appeared in multitudinous types and varieties, impeding, non-inductive, polarized, locking, etc. It is only quite recently, however, that successful alternating-current types have appeared, and a relay of such a type is the subject of a patent to W. W. Dean, included in the issue of March 17.

Mr. Dean's relay is particularly designed for use at the stations of party line subscribers where the Bell company's four-party line selective ringing system is used. In this system the ringing currents consist of successive impulses of current all of the same sign, with corresponding and intervening periods of time, during which no current passes. The armatures of the bells used with this system are given a permanent set toward one pole piece by a spiral spring, so attached that after the armature has responded to an impulse of current the back stroke will be completed by the spring during the period of no current. In order to use this apparatus for four selective stations, generators of positive impulses and of negative impulses must be provided, and the bells must be poled to respond only to currents of proper sign. Then by using a ground return,

two independently signaled stations may be wired to each side of the line.

To all who are familiar with central energy working, it will be at once clear that such a system would be impracticable unless the bell circuits are kept normally open to direct currents. Further, a moment's consideration will show that a condenser will not suffice, as its presence will convert the single sign impulse currents into alternating currents consisting of impulses of both signs. Such currents would ring more than the one bell. The only alternative for opening this circuit is a relay at each station to connect the bells to the line at the moment of ringing. Such relays are provided and are permanently connected in series with a condenser and bridged across the line. The grounded bells are then connected to the contacts of their corresponding relays.

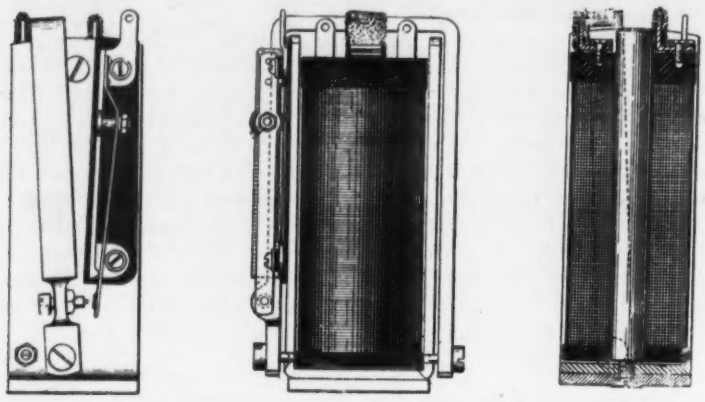


FIG. 1.—DEAN RELAY.

The controlling features of the required relay are as follows: It must not shunt out the bell; it must maintain its contact during the intervals of no current, and it must be almost noiseless, so as not to disturb stations not called.

All of these conditions have to be met by the present relay and how this has been done may best be explained by reference to Fig. 1, which shows a section and two elevations of it. Upon the central core, which is placed vertically, a winding of very many turns is provided, being contained between square heads of hard rubber. The completed spool is then secured within a U of iron which serves as a return pole piece. This forms the body of the relay.

The armature is also U-shaped, but is much narrower than the body U. It is inverted and pivoted to span the body U, as shown, the pivots being in line with the center line of the core. As will be noted, the body is shaped to conform to the line of motion of the armature. When the armature is in the unactuated position shown, the magnetic pull to move it forward is quite large. On the contrary, when it has once moved forward, the turning force becomes almost nil, the magnetic pull being almost all exerted against the pivots. Thus, as the armature proceeds, the turning or actuating moment falls off. This tends to make the relay strike its stop lightly, even though the starting force be quite great, and this, combined with the presence of a felt covering upon the stops, tends to make the relay noiseless in its operation.

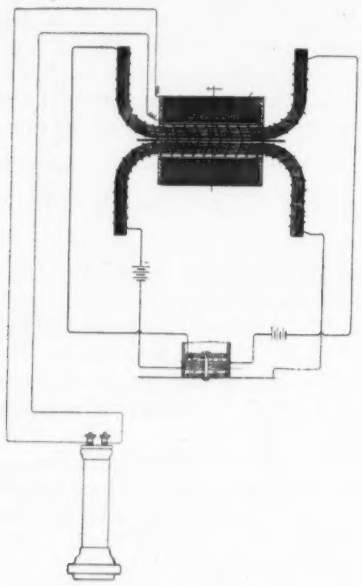


FIG. 2.—PARCELLE INDUCTION COIL.

The slow return of the armature and its consequent disregard for the period of no current is due to the reduction of the gavitational returning moment, as the center of gravity of the armature passes almost over the supporting pivot points. The patent for this relay has been assigned to the Western Electric Company.

A second telephone patent of the issue of March 17, describes a multiple magnetic circuit induction coil. This is the invention of A. L. Parcelle, of Boston, Mass., and is shown somewhat diagrammatically in Fig. 2. Within a secondary winding having a large aperture two distinct primaries are threaded. Each primary coil is wound upon its own iron-wire core, the ends of which are so bent that the poles of the two cores are non-interfering.

In using the coil a double transmitter is to be employed, the sections being so connected mechanically that the pressure vibrations within them will be 180° apart in phase. Each of these sections is wired to its own primary, and these latter are connected in opposition. There is, therefore, an active increasing wave of magnetization continuously effective in one of the cores, assisting the secondary current induced by the dispersal of the magnetic lines in the other core. Thus, the distortion of the wave induced by the dispersal of lines, which dispersal is always affected by magnetic lag, is reduced to a minimum. The inventor states that this arrangement of induction coil results in great clearness of transmission.

## CURRENT NEWS AND NOTES.

*RECTIFYING ALTERNATING CURRENTS.*—Two patents issued March 17 to Prof. Elihu Thomson relate to means for rectifying alternating currents whereby the rectifying brushes are automatically shifted with change of phase relations, so that the commutation will always be effected at an instant favorable to the least sparking effect. This is accomplished in connection with the use of a constant-current transformer in the current rectification, the movement of the coils of which acts to move the brushes of the rectifier.

*ELECTRIC HEATING PATENTS.*—Three patents on electric heating were issued on March 17, two of them to H. V. Loss and the third to J. S. Peck and K. C. Randall, all three being assigned to the Westinghouse Company. The two patents issued to Mr. Loss relate to an apparatus for electrically heating rivets, which is adapted to receive rivets of widely different lengths and diameters, and by means of which the point of the rivet may be heated to a less degree than the other parts. The electrical contact is between the head of the rivet and a point in the body of the rivet more or less removed from the point. The third patent is also on an apparatus for heating rivets, and is so designed that the rivet may be readily and securely clamped between the electrical terminals and as readily released when the heating operation is completed. A single terminal engages the head of the rivet and means are provided for forcing this terminal forward so as to increase the clamping action of a two-part terminal, which engages the rivet near the point.

*A TESLA WIRELESS TELEGRAPH PATENT.*—The preamble of a patent issued March 17 to Nikola Tesla disputes the utility of selective wireless telegraph circuits tuned to but a single frequency, and the specifications describe a method in which there are two or more tuned circuits at each station. At the sending station there would be say two separate transmitting circuits, each with its antenna, and tuned to different frequencies, but both controlled by the same sending key. At the receiving circuit there would also be two separate antennæ and receiving circuits, but the latter would act conjointly on a third relay included in the local recording or sounding circuit. The latter will only operate when the two receiving circuits simultaneously respond to the definite frequencies of the two sending circuits. Thus, should the frequency of one of the receiving circuits happen to accord with that of a disturbing source of Hertzian waves, there would be no signal, since the third relay is only actuated when both receiving circuits respond simultaneously to the respective frequencies for which they are tuned.

## University of Wisconsin Branch of the A. I. E. E.

A meeting of the Madison (Wis.) branch of the American Institute of Electrical Engineers was held in the Engineering Building of the University of Wisconsin on Thursday, March 12th. The papers on "Railway Car Lighting," read at the 173d meeting of the Institute in New York City, February 27, were abstracted by Mr. E. B. Mueller. This was followed by a general discussion of the subject by the members present.

This local chapter was organized in October, 1902, and meetings are held weekly throughout the college year. The papers read at the monthly meetings of the Institute are taken up at one meeting of each month, and the remaining sessions are devoted to other engineering subjects of interest. The chairman is Prof. B. V. Swenson and the secretary, Mr. C. Shaad.

# LETTERS TO THE EDITORS.

## Meter Testing.

*To the Editors of Electrical World and Engineer:*

SIRS:—Regarding the opinion in your editorial of March 21, that the portable test meter referred to is only applicable for the testing of wattmeters having removable covers, I may say that although the instrument is principally designed for testing removable-cover, direct-current motor meters, it is used almost daily for testing meters which are permanently sealed; and that while the slide-rule is sometimes found necessary, the entire calculation consists in dividing a whole number of revolutions by a fractional number, necessitating only one setting of the slide-rule.

The scheme which you suggest has been used for testing in the central station. In this method the tester uses a tabulation showing the exact load which each meter must be given in order that it should make a certain number of revolutions in a given time. One of the objections to using this method for testing meters in place is that it involves the use of a rheostat of such construction that any desired load may be exactly obtained and held constant in spite of varying voltage. Such a rheostat is apt to be bulky and complicated. Again, in case of any sudden change in voltage the needle of the indicating wattmeter may swing to an undesirable extent. Another objection is that a stop-watch is required, and it is generally known that none but very expensive stop-watches will stand the work imposed on them in continuous meter testing. Even granting that the load is held perfectly accurate and steady and that the stop-watch works perfectly, it is still necessary in order to determine the per cent. accuracy to divide the number of seconds in which the meter should run by the number indicated by the stop-watch or else to consult a table.

Using the special watt-hour test meter, the load applied, on the contrary, need not have any exact value, and the voltage may fluctuate to any extent without interfering with the accuracy of the test. The portable test meter system has also the advantage of using the slide-rule only in the case of permanently sealed meters, and the stop-watch not at all. W. J. MOWBRAY.

BROOKLYN, N. Y.

## Power Required to Drive Machine Tools.

*To the Editors of Electrical World and Engineer:*

SIRS:—In your issue of March 7 I find a criticism of my article on "Power Required to Drive Machine Tools in Locomotive Shops." The author shares the critic's regrets that more complete information regarding cutting speeds, depths of cuts and rates of feed could not have been obtained. However, the primary object of the tests was to find the average load on the motors in everyday working conditions and to determine whether or not the motors were adapted to their loads. There was only a limited time in which to make the tests and we were not permitted to interfere to any considerable extent with the regular operation of the shop. We realized that more complete information along the lines suggested by Mr. Sands would have been desirable, but did not think the circumstances favorable for obtaining it. Mr. H. M. Palmer, of the Westinghouse Electric & Manufacturing Company, who worked with me on these tests, is, however, engaged in compiling a very extensive collection of data on this interesting and important subject and has facilities for carrying on investigations on individual machines, with all conditions of feed, speed, nature of cutting tool, etc., under control, thus being able to obtain much better results than would have been possible in any case at Du Bois. If Mr. Sands has some particular installation in mind to which he would like to apply such information, he might be able to obtain it by taking the matter up with the Westinghouse engineers. GEO. H. GIBSON.

JAMAICA PLAIN, MASS.

## Wireless Telegraphy in Alaska.

*To the Editors of Electrical World and Engineer:*

SIRS:—While it has not been the custom of this company to give serious attention to misstatements which occasionally appear in print regarding the progress of the Marconi system of wireless telegraphy toward a successful solution of the problem of the commercial value of the art, we should show an unexplainable lack of interest if we neglected to deny publicly certain ingenious misstatements appearing in your issue of March 14th. The fact that the news item containing the misstatement has appeared in ELECTRICAL WORLD AND ENGINEER, a publication circulating widely among the scientists and practical electricians of the world, gives more weight and substance to the inaccuracies than if presented in a general newspaper.

The article referred to is headed "Wireless Telegraphy in Alaska," and the impression evidently sought to be conveyed is that the Marconi installations in course of construction in Alaska under contract with the United States Signal Service, has, up to the present time, failed to operate properly and satisfactorily. There is also the intended intimation that the De Forest Wireless Telegraph Company has performed better service than the Marconi Company. The facts are these:

The United States Signal Service advertised for bids for the installation of wireless telegraph stations via four routes, designated as A, B, C and D respectively. A and B were practically the same routes, which is also the case with routes C and D. Route B was designated in the advertisement of the Signal Service "between Fort Davis (Nome City) and Fort St. Michaels," and route D "between Fort Gibbon and a point on the Tanana River, at or near the mouth of the Delta River." The former route was awarded to Queen & Company, of Philadelphia, presumably representing Prof. Fessenden, and the latter to the Marconi Company. The De Forest Company also filed a bid, which, for some reason, was not accepted by the government officials.

On June 9, 1902, a contract between the disbursing officer, Signal Corps, United States Army, and Marconi Wireless Telegraph Company of America was executed, and the construction of the stations provided for in the contract was proceeded with by the Marconi Company. The contract contained the provision that the station "at or near the mouth of Delta River and Bates Rapids, will be accessible to boats propelled by steam or other power." Unfortunately, this did not prove to be the case, and our engineers upon arriving at the head of navigation on the Tanana River, found it impossible to reach the site selected for the station, with their apparatus. A month of valuable time was lost in communication with officials of the Signal Corps in Washington, the local officer in charge being unwilling to assume the responsibility of allowing any change in the station site. Eventually, orders were issued from Washington allowing a more accessible site, but the time left of the short Alaskan summer was not sufficient to allow the completion of the stations. Our engineers, therefore, proceeded homeward, catching the last boat down the Tanana before the close of navigation.

Although the time specified in the contract for the completion of the stations expired October 1st, 1902, the chief signal officer has tendered proposals for completing the stations, and our engineers will proceed to Alaska for that purpose as soon as navigation opens.

The ingenious, but malevolent statement "notwithstanding the apparent success of the wireless system commercially, none of the companies offering to install a system between Cape Nome and St. Michaels, in Alaska, has succeeded in getting its system to work," while strictly true, we believe, since that route was awarded to Queen & Company, and has not been completed, when coupled with the statement following "that up to the present time Marconi has accomplished nothing so far as the Alaska wireless proposition is concerned," shows forth the animus of the whole article, viz.: to discredit the Marconi system to the advantage of another system which

gives "some evidences of sincerity," according to the article. We believe, we are safe in asserting, that the only "evidences of sincerity," shown by the De Forest Company in connection with Alaskan installations for wireless telegraphy, consist in submitting a bid for installations which were rejected by the Signal Service. We have to submit for unprejudiced decision that we have given more "evidences of sincerity" up to the present time than any other company, in our efforts to develop wireless telegraphy in Alaska.

The Signal Service experiments referred to "between the army posts about San Francisco," must necessarily comprehend the exhaustive investigations of the possibilities of wireless telegraphy carried on between Fort Mason in San Francisco and Alcatraz Island, a distance of one mile. These are the only two posts equipped by the Signal Service in the vicinity of San Francisco.

Whatever the ultimate results of the present endeavor of the Marconi Companies to establish the commercial value of this new and wonderful art, they have sanctioned no sensational methods to awaken interest temporarily for speculative purposes. The present stage of commercial usefulness as exhibited in results already accomplished gives ample faith for better results. There is no other system than the Marconi which regularly accepts commercial business for ship-to-shore transmission. There is no other system than the Marconi which can communicate with the large fleet of steamers which enter and leave New York harbor. There is no other system than the Marconi that has evidenced its faith in wireless telegraphy by installing three expensive stations for transoceanic service, and no one but Mr. Marconi has transmitted messages through space over three thousand miles of ocean.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.
NEW YORK CITY.

# DIGEST
OF
# CURRENT ELECTRICAL LITERATURE.

## DYNAMOS, MOTORS AND TRANSFORMERS.

*Design of Large Dynamos.*—ESSON AND SCOTT.—The conclusion of the summary of the two papers of Esson and Scott, recently read before the (Brit.) Inst. Elec. Eng. The notes given in this issue refer to magnet steel, the forms of brush holders, the forms of poles, the armature hub, the armature core, the slots and the winding of armatures. The following notes are abstracted from Scott's papers. Designers appear to be practically agreed that to get sparkless commutation and a minimum zone of movement of the brushes, there must be a certain relationship between the ampere-turns for the air-gap at full load, and the cross ampere-turns of the armature. Some say that the best relationship is when the one divided by the other gives unity, or thereabouts. At the same time many machines, especially those made in America for traction purposes, show figures which, according to this rule, would indicate a precarious design. He gives as an example the figures for four large generators in which the ratio of gap ampere-turns to cross ampere-turns is 0.631, 0.61, 0.68, 0.65. If good commutation can be obtained with this ratio much lower than unity, then such a machine will be a cheap one, because a large number of cross ampere-turns means that a larger output is obtained from a given carcass. The following points tend to this result: the use of carbon brushes; the saturation of the pole-shoe, especially at the pole tips; the saturation of the teeth of the armature core; the use of high-resistance commutator lugs for the segments; the over-compounding of the fields. He considers the last a most important feature, because the increase of magnetization occurring with increase of load comes into action just at the critical moment when it is required. He suggests that it is a question whether it would not be as well to compound all dynamos, simply with this object in view; in a central station for lighting it would mean a little extra cable and switch apparatus, but this would be much more than covered by the greater output obtainable from a given machine and the improved commutation under varying loads. As the motor load grows in any particular area, the conditions which the dynamos have to meet approximate more and more to those of traction generators which are always compounded, and run well in parallel without trouble. On the other hand, the fact that practically all lighting networks are on the three-wire system and that batteries are generally used, are points in favor of keeping to shunt machines. —Lond. *Elec.*, February 6.

REFERENCE.

*Design for a ½-HP Self-Starting Single-Phase Induction Motor.* —An illustrated article with dimensional drawings giving all the essential features of a self-starting induction motor capable of giving one-half brake hp on a single-phase circuit of 100 volts and 125 to 133 cycles.—*Am. Elec.*, March.

## LIGHTS AND LIGHTING.

*Nernst Lamp.*—STOETTNER.—An abstract of a paper read before the (Brit.) Inst. Elec. Eng. on the types of Nernst lamp, made by the General Electric Company of Berlin, which also holds the patents for England. Two types are now in use; the A type is made for 1 amp up to 250 volts and for ½ amp only from 200 up to 250 volts; the metal hood is furnished with metal combs of thin sheet copper in the inner cover, for the purpose of cooling the "bolstering" resistance, and between this inner tube and the outer mantle are a number of tubes for ventilation purposes and facilitating the radiation of heat; the latest B type is made for ¼ and ½ amp up to 150 volts and for ¼ amp up to 250 volts. In these lamps the compensating or "bolstering" resistance (called the ballast resistance in this country) is made of iron wire sealed in a glass globe which has been exhausted and afterwards filled with hydrogen. As to efficiency and life, he refers to tests of the Reichsanstalt, mentioned before in the Digest. He says that a great many errors are committed in the treatment of Nernst lamps, in consequence whereof numerous complaints of short life, etc., are lodged with the suppliers; but if instructions are carefully followed a life of about 300 to 400 hours may be expected. It is a mistake to "overrun the lamps, as the surplus current is taken up by the "bolstering" resistance, and practically the light is not the least increased." Another great mistake is to connect the lamp in the wrong way. In continental Europe the screw holder is in almost universal use, and the standard rule is to make the center contact minus; it is, therefore, immaterial how frequently the lamps are taken out of their holders, as they always come back to their proper position. With bayonet lamps it is different, the poles can be easily changed by inserting the lamps the wrong way, and to prevent this the makers have designed a tool to cut out a slot, and have provided the porcelain socket of the lamp with a third pin, so that it is impossible to get the lamps into the holders the wrong way. To determine the polarity on bayonet sockets, special pole finders are supplied, the negative pole being invariably indicated by the red appearance of the solution. In the discussion which followed Drake, Solomon and Swinburne gave an account of their work done with the Nernst lamp for the Nernst Electric Light, Limited, which holds the patents for certain British colonies; they give curves showing the results of tests of their lamps; they gave up the manufacture of the lamp on account of the chemical and mechanical difficulties in making the filaments. Hammond spoke about his use of 40 Nernst lamps for street lighting in Hackney, as an experiment on a mile of streets. From the results he concluded not to recommend at present the extension of the use of the Nernst lamp over all the streets of Hackney, on account of the non-uniformity of the life of the different lamps, as they "could not have street lighting with certain lamps out and certain lamps alight." The life of the different 40 lamps varied from "1,070 hours and still burning" down to 15 hours; the average life of the lamps which had burnt out was 305 hours. His report on these results is reprinted in full.—*Lond. Elec.*, March 6.

## POWER.

REFERENCES.

*Electric Cranes.*—An illustrated description of the electric crane

installation at the Manchester Ship Company's docks. There are 22 cranes in all, of which 12 are portable, being mounted on carriages. Direct-current motors are used.—Lond. *Elec. Rev.*, March 6.

*Fan Motors for 1903.*—A profusely illustrated article describing the various fan motors available this year. *Am. Elec.*, March.

*Liquid Fuel.*—SCHMIDT.—An article in which the author enumerates the advantages of liquid fuel, and also treats of the method of feeding.—*Am. Elec.*, March.

TRACTION.

*Standardization in Electric Railway Working.*—An editorial stating that an important conference at which all the leading railway companies of the United Kingdom are said to be represented, has recently taken place for three weeks in London, with a view to arriving at an arrangement which will insure the adoption of a uniform system of electrification on all their lines. This fact is said to be significant, as it shows that the irresistible march of progress has compelled them to take into very serious consideration the possibility or rather the prospect of the future conversion of their railway systems to electrical operation. It is pointed out, however, that decisions on standardization at the present moment would not only be ineffectual, but also directly harmful to the progress of the industry. The conditions of urban, suburban and interurban railways are entirely different from those of long-distance roads, and it is not probable that the same system will do for both cases. Reference is made to a recent trial of the huge steam locomotive, "Decapod," of the Great Eastern Railway, which was designed with a view to ascertaining whether it is possible to attain as good results with steam as with electric propulsion in suburban traffic; in 30 seconds this machine can attain a speed of 30 miles per hour, or 44 ft. per second, an improvement of 50 per cent. on the most powerful engines hitherto constructed in the shops of this railway; but this is said to represent the very last word of the steam engineer in his efforts.—Lond. *Elec. Rev.*, March 6.

*Freight and Express on Electric Railways.*—COOPER.—The conclusion of his article. Fifty per cent. of the interurban railways in the United States do a regular express and freight business, while over 25 per cent. of the remainder carry packages to a greater or less extent. As yet little has been done in standardizing the rates at which this business is done, as the rates have been based on local conditions. This the writer believes will cause confusion and trouble later. These rates vary from one cent to $3 per hundred pounds per mile. Instances are given of the practice of different companies in the transportation of different articles. Eleven roads haul regular freight cars over their lines; the rates of these are given.—*St. R'y Jour.*, February 14.

*Car Dispatching by Telephone in Buffalo.*—The Buffalo Railway Company has instituted a system of 250 telephones, as shown in a diagram. A dispatcher is located at the central exchange to instruct conductors and others as to what to do in cases of emergency, and if an accident occurs the conductor can be placed in immediate connection with the claim department, which thus gets the earliest information of the accident. The cars on the interurban lines are dispatched by telephone.—*St. R'y Jour.*, February 28.

REFERENCES.

*Choice of Engines for Moderate Traction Stations.*—E. K. SCOTT.—An article in which he draws attention to the great importance of simplicity of design and puts in a plea for the ordinary tandem-compound, single-crank engine and for the use of high superheating.—Lond. *Elec. Rev.*, February 27.

*Plans for Extension of the New York Subway and "L" Systems.*—A map showing by heavy lines the proposed extensions in New York and by light lines the existing roads, with the exception of the surface lines.—*St. R'y Jour.*, February 28.

*Combination Sweeper and Sprinkler.*—A description of a machine which has been built for Ilford, England, and is fitted with the usual tank and sprinkler for spraying the street and also with a rotating brush. The latter can be driven at any speed and can be raised and lowered from either platform. Although the car takes considerable current, it takes less than if two separate cars were used, and there is of course an economy of labor from the use of a single car to perform both functions.—*St. R'y Jour.*, March 7.

WIRES, WIRING AND CONDUITS.

REFERENCE.

*Determining the Distribution of the Current in Electric Networks.*—HERZOG AND FELDMAN.—A long communication in which they reply to recent criticisms by Monath and Teichmueller, of the practicability of their and Kennelly's transfiguration method of determining the distribution of the current in networks.—*Elek. Zeit.*, February 26.

ELECTRO-PHYSICS AND MAGNETISM.

*Polar Heating Produced by Sparks.*—VILLARI.—An account of an experimental investigation, but the abstract from which this is taken is not clear. He found that sparks from a condenser passing from one pointed thermo-couple to another or to a sphere or disc, heat the thermo-couple in nearly the same proportion, no matter whether it is positive or negative, but the heating greatly depends upon the gas through which the sparks pass, being about 2½ times as great in nitrogen as it is in hydrogen. "When the sparks are supplied by an induction coil, the heating is much greater at a negative thermo-couple than at a positive one." This difference of heating is a peculiar phenomenon which is not due to any difference in current intensity produced by reversal. In rarefied nitrogen, which has a small resistance, both direct and reversed sparks pass and the discharges are much more energetic; therefore, the polar heating by these discharges is much greater than in nitrogen at atmospheric pressure. "By passing the same current through two bulbs in succession, one of which contains nitrogen at ordinary pressure and the other rarefied nitrogen, it is found that the cathode is always more strongly heated than the anode." The author recalls the analogy of the electric arc which experiences a higher resistance in hydrogen than in air.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

*Radio-Activity near Waterfalls.*—MACLENNAN.—An account of the investigation of the radio-activating process at the foot of waterfalls. Lenard showed that very anomalous electric conditions hold at the foot of Niagara Falls, where the impact of the water upon the rocks gives the water a positive and the spray a negative charge. The present author studied the radio-activity at the foot of the falls. The general result is that the radio-activity acquired under these abnormal conditions was very much smaller than that acquired under ordinary circumstances at Toronto. The measurements were made with a copper wire carried on ebonite insulators, and charged to 10,000 volts by means of a Toepler-Holtz machine. The radio-activity was compared with that produced by a standard radium preparation. The greatest radio-activity obtained at Niagara was 0.3 and the least at Toronto was 0.6; but, as a rule, the Toronto values were six or seven times as high as the Niagara values. The wire always got charged at once with the spray, sometimes to 7,500 volts.—*Phys. Zeit.*, February 27; abstracted in Lond. *Elec.*, February 27.

*Thermo-Cells.*—HEIL.—A description of a new thermo-cell designed by him. After giving a table of the thermo-electric forces of different materials, he says that the highest e.m.f. is produced by constantan (a Cu 60 Ni 40 alloy) against an antimony-zinc alloy (Sb 100 Zn 57), which is what he uses for his thermo-cell. A small percentage (3 per cent.) of iron to the antimony-zinc alloy strengthens it. The efficiency of his thermo-cell is 2.46 per cent. for the total energy, or 1.23 per cent. for the useful energy. The corresponding figures for the Guelcher thermo-cell are 0.864 and 0.432. He claims that the efficiency of his thermo-cell is superior to that of very small steam-driven dynamo sets.—*Zeit. f. Elektrochemie*, January 29.

*Loud Speaking and Singing Transformer.*—KRAETZER.—A brief communication on an observation made by him on experiments with the speaking arc. He found that when the speaking arc refused to speak the transformer would start to speak and sing under certain circumstances. The success of the experiments depends upon a distinct magnetic excitation of the core. *Elek. Zeit.*, February 26.

ELECTRO-CHEMISTRY AND BATTERIES.

*Edison Battery.*—A brief editorial note on a recent inspection of a sample of this cell and its component parts. "The cell is a model of excellence in mechanical construction; being composed mainly of steel, it afforded the designers a rare opportunity of which they have availed themselves to the full. * * * If all the claims advanced for this cell, or even a part of them, are fulfilled, we may look for more important results from its introduction."—Lond. *Elec. Rev.*, March 6.

HIBBERT.—A short article with discharge curves. He examined a cell which had never been used; it weighed 18 lbs. and had a 200-kw capacity; the striking feature is the small loss in the ampere-

hour capacity when discharged rapidly; the cell is nominally rated at 25 amp, and then gives about 160 amp-hours at a potential difference of over 1 volt; for eight times this normal discharge current, the ampere-hours, with a continuous discharge down to 1 volt, are practically 125. "During discharge the density of its liquid is not diminishing, but rather increasing. Hence the ability to call on a greater fraction of the available energy at a higher discharge rate." The manufacturers claim that there is no local action. The ampere-hour efficiency is only 2 or 3 per cent. less when 10 or 12 days intervene between charge and discharge than when discharge immediately follows charge. "The general result of an examination of the cell is to remove some antecedent skepticism, and one feels that there is a serious competition to the lead cell not far away. The final decision will appear when the cells are offered to the public and get tried by the infinitely varied rough usage and nescience of the general public. A preliminary to that stage will be reached when an adequate report has been made by outside authority. I understood Mr. Dick to say that this is being arranged for, and till then we must wait with such patience as we can command."—Lond. *Elec. Rev.,* March 6.

Hibbert.—Another article giving some abstracts from American journals on this battery.—Lond. *Elec. Rev.,* February 27.

*A New Synthesis of Hydrocyanic Acid.*—Gruszkiewicz.—A brief article on an electrochemical method of making hydrocyanic acid, which may develop into something of practical value. The electric furnace is not suitable, as the high temperature is apt to decompose the product; a method based on discharges must be used. Its production from acetylene and nitrogen by this method has been tried by Berthelot, but the acetylene is easily decomposed into carbon and hydrogen; this may be avoided by adding hydrogen, about ten times that of acetylene. The present author repeated these experiments and found that while the deposition of carbon does not take place to any such degree as in pure acetylene, nevertheless it occurred; but if the gas mixture did not contain more than about 5 per cent. of acetylene (and 5 per cent. nitrogen and 90 hydrogen), there was no longer any deposition of carbon. But as this is far too expensive and complicated to be of practical value, he experimented with a mixture which is cheap, containing carbon monoxide, nitrogen and hydrogen (water gas, Dowson gas, generator gas) and found that under proper conditions hydrocyanic acid may be obtained. The best conditions for the formation of hydrocyanic acid are a percentage of 49.79 to 52.44 per cent. of CO in the mixture; the electrodes must be very near together.—*Zeit. f. Elektrochemie,* January 22.

*Commercial Cyanide of Potassium.*—Whitby.—An abstract of a paper read before the Chemical and Metallurgical Society of South Africa. He gives details of some tests made to show how the present system of purchasing cyanide for commercial use in the gold industry left the manufacturers a very wide margin for impurities. It is extremely easy for the manufacturer to comply with existing conditions, and yet supply the consumer with a lot of things he can do without. He then discusses the importance of these unnecessary impurities. The effectiveness of the mixed sodium and potassium cyanides being accepted, it would appear desirable to adopt the use of a sodium cyanide and not to call it potassium cyanide; also demanding an efficiency of at least 50 per cent. cyanogen. Or if potassium cyanide is to be used some limit should be stated for the sodium cyanide.—*Eng. & Min. Jour.,* February 28.

*Electrolytic Preparation of Oxygen and Hydrogen.*—An illustrated description of the Schoop method for the electrolysis of water. For soldering purposes the use of pure oxygen-hydrogen is superior to ordinary hydrogen, as the temperature is higher. In the application of a Schoop apparatus for a year, the following results were obtained: one electric hp-hour gives 97.5 liters of hydrogen and 48.75 oxygen (probably under atmospheric pressure); i. e., 6.8 hp-hours are required for one cubic meter of mixed gas; with warm acid (sulphuric acid of 1.23 specific gravity being always used), this value is reduced to 6.2 hp-hours; for 1 cent per hp-hour the cost of one cubic meter of mixed gases is 4.2 to 4.8 cents. The purity of the oxygen is 99 per cent.; that of the hydrogen, 97.5 to 98 per cent.—*Centralblatt f. Accum.,* February 15.

*The Calcium Carbide Industry in France.*—An article on a report issued by the German consul in Havre. The Bullier patents have finally been proclaimed good in France by the Court of Appeals. The company owning this master patent is practically the owner of 17 carbide factories scattered throughout the Alpine districts; its 50 agencies are compelled to sell at the uniform price of 363 francs per metric ton. The annual production is estimated at 18,000 tons. Forty villages are provided with central acetylene installations. The existence of the Bullier patent has prevented the importation of any carbide, but the export trade is growing. Most of the large steamship companies still dislike taking carbide on board, and leave the carrying trade to the "tramps."—Lond. *Elec. Rev.,* February 27.

*A New Method for Heating Furnaces.*—Rasch.—An article in which he expresses the opinion that the electric arc furnace and the use of high-tension electric discharges with carbon electrodes, are suitable only for special purposes; the following requirements must be fulfilled for pyrochemical reactions in general; the electrodes must be capable of withstanding a high energy density and a high temperature; they must not be oxidized and they must not produce a reducing action on the reaction to be obtained. Carbon does not answer and he suggests using for pyrochemical reactions conductors of the second class, which are chemically very persistent, and stand a high temperature. Among such conductors are rods or tubes of magnesia, aluminum oxide, etc.; but they must be preheated.—*Zeit. f. Elektrochemie,* February 19.

*Electrodes Sensible to Light.*—Kochan.—An account of an experimental investigation of a gold electrode, which was effected by light. Bose had found that a pair of gold electrodes in dilute sulphuric acid, which had been charged with 110 volts, had a different e.m.f. in the dark than when lighted, and that the oxygen electrode was the real seat of this sensibility to light. The present author made a long series of tests with this type of cell, in which he investigated the influence of light of different colors and the action of Röntgen rays.—*Zeit. f. Elektrochemie,* January 8, 15, 22.

REFERENCES.

*Electric Analysis of Mercury.*—Glaser.—An account of an experimental study on the electric analysis of mercury and the solubility of platinum in potassium cyanide. The difference observed in the electro-analysis of mercury from a potassium cyanide solution are due to an attack of the platinum disc serving as cathode and to the solubility of platinum in potassium cyanide.—*Zeit. f. Elektrochemie,* January 1.

*Action of Iodine on Alkalies.*—Foerster and Gyr.—In a continuation of their investigation of the action of halogens on alkalies they describe the action of iodine.—*Zeit. f. Elektrochemie,* January 1.

*Catalytic Action.*—Bredig and Watson.—A preliminary account of an experimental investigation of the kinetic reasons underlying the fact that a solution of potassium iodide produces a catalytic action upon hydrogen peroxide, the latter being decomposed into water and oxygen.—*Zeit. f. Elektrochemie,* February 5.

## Units, Measurements and Instruments.

REFERENCE.

*Interrupter.*—An illustrated description of a high-speed "trembler" of French manufacture for induction coils for producing the sparks in internal combustion engines of automobiles. It is claimed to permit practically unlimited speed of the motor, and yet give perfect sparking under every condition. With a 4-volt current it makes 436 interruptions per minute.—Lond. *Elec. Rev.,* March 6.

## Telegraphy, Telephony and Signals.

*The Core Ratio of Submarine Cables.*—Young.—The first part of an illustrated article on the ratio of resistance to capacity in long submarine cables, and some related quantities. Comparisons of signals on submarine cables having different ratios of resistance to capacity are liable to be misleading unless the e.m.f. and terminal resistances and capacities are adjusted to the ratio of $R$ to $S$ of the line. The quantities dependent on the design of the core are: the e.m.f. of the battery; curbing (sending or receiving end); the maximum and mean pressure on the cable; the best resistance of the battery for given maximum pressure; the best resistance and inductance of the receiver; and duplex adjustments. All these factors depend upon the ratio of $R$ to $S$, or rather upon the square root of the ratio of $R$ to $Sp$, where $p$ is the coefficient involving the shape of the wave, or the time rate of change of the force; it is, in short, the quantity by which the instantaneous volts must be divided to find the instantaneous amperes. If telegraph signals were made by successive reversals, instead of by irregular combinations of impulses, these problems could be dealt with by the methods of alter-

nating-current practice; but they are not, and if these methods are nevertheless applied, it is because it is the best approximation we have at present. His conclusions are arrived at on the understanding that the circuits whose $R$ to $S$ ratios are under comparison, either have equal $S$ $R$ values or else are worked up to the maximum speed given by the $S$ $R$ law. The usual figure for this is 600 divided by $S$ $R$ letters per minute for what may be defined as "long" cables, whose $S$ $R$ is not less than about 3.5 seconds, below which limit the disabilities of transmitting and receiving apparatus begin to come into prominence and lower the speed rapidly. He then discusses the amplitude of signals; for "direct sending," the lower the $C$ $R$ per microfarad of the core, "$C$ apparently signifying the current," the shorter the contacts required to produce signals of a given size, with a given battery; with direct-sending and constant-battery resistance the e.m.f. necessary to generate signals of a given size is directly proportional to the square root of the $C$ $R$ per microfarad of the core. When sending or receiving through a condenser the curbing of the impulse is the primary adjustment. On a core of high $C$ $R$ per microfarad the time constant of a given condenser is larger, and to preserve the sharpness of wave form, the condenser capacity must be reduced in the inverse ratio of the square root of the ratio of $R$ to $S$ in order that the signal may be correctly curbed. To get a given amplitude with constant curbing, the e.m.f. must be raised as the square root of $C$ $R$ per microfarad after the above adjustment of the condensers. He then discusses the "curbing" of signals; for direct sending the lower the $C$ $R$ per microfarad, the shorter is the correct duration of curbing contact, relatively to the main one, required to insure straightness of signals. A somewhat important matter in connection with the e.m.f. used on submarine cables is the maximum pressure produced on the dielectric at the sending end. The mean or effective pressure on the cable is kept constant when the capacity of the sending condenser is made inversely as the square root of $C$ $R$ per microfarad. The maximum pressure on the cable is kept constant by making the capacity of the sending condenser vary inversely as the square root of the ratio of $R$ to $S$ of the core, with constant e.m.f. negligible battery resistance. —Lond. *Elec.*, March 6.

## New Books.

DESIGN OF DYNAMOS. By Silvanus P. Thompson, D. Sc., F. R. S. New York: Spon & Chamberlain. 253 pages, 92 illustrations, 8 plates. Price, $3.50.

This is one of the most interesting books on its subject that has thus far appeared, and it is also remarkable for its unevenness of merit. Parts of it are invaluable to anyone directly interested in dynamo design; other parts are of merely academic value, while still other parts are open to adverse criticism.

The author begins with magnetic data and calculations, which are expounded in his well-known clear style; for when Prof. Thompson thoroughly knows a thing, no author can explain it better than he. This chapter contains some very useful charts and tables showing the specific losses due to hysteresis and eddy currents under various practical conditions, and includes a description of three methods of ascertaining the stray field coefficient of a machine, one of which is excellent, one tolerable and the other of doubtful value. A table of coefficients applying to various types of machines is also given, but it is problematical, for the reason that the types to which it refers (by numbers) are not identified anywhere in the book. It is gratifying to note that the author has dropped the method of calculating field excitation on the basis of reluctances, and works now in ampere-turns per inch length of path (which method, incidentally, was used by the reviewer twelve years ago). In considering the path in the air-gap, however, the author advocates the doubtful method of calling the air-gap area the mean of the pole-face area and the area of the tooth heads under a pole. With partly closed slots this might serve, but with straight slots the effective air-gap density is appreciably less than this method would make it. As a matter of fact, it is a waste of time to try to calculate air-gap areas; the average magnetic density taken over the pole-face is an adequate criterion of operative conditions, and this value is readily computed. Another dubious method suggested is to take the *average* width of an armature tooth in considering the path there. The density at the root of the tooth is invariably the prime criterion, the average width of the tooth being a misleading factor because of the wide differences in permeability at different points along the tooth. With reference to the length of air-gap, the author says on page 39 that it should not be much less than 1½ times the width of an armature slot; but by the time page 137 is reached, he appears to have changed his mind and recommends half the width of a slot.

Chapter III on copper calculations is excellent, barring a few typographical and slide-rule errors, and a superfluous discussion of "space factor." The conductors in a slot must be adequately insulated from the core, regardless of "space factor," and while everyone recognizes that as many conductors as possible should be put in one slot in order to economize insulation space, there are limitations to the allowable dimensions of a slot which "space factor" cannot alter. The errors in this chapter are as follows: On page 44, in the rules for copper wires at 30° C., "section in sq. mils" should read "circular mils" in the first two rules; on page 48, "coil" should read "wire" in the third line from the bottom; on pages 50 and 51, "1.045" should read "1.0045"; on page 53 the first formula has the sign of equality omitted between $\frac{V}{C}$ and $M$, and is, therefore, unintelligible as it stands.

Chapter IV is devoted to insulating materials, and contains much practical data compiled from various well-known sources. In Chapter V the author gives undue space to armature-winding schemes, and also makes several careless statements. Thus, on page 96, "if in any wave winding the number of circuits is made equal to the number of poles, . . . . the winding becomes identical to a simple lap winding." The fact is that multi-path wave windings are used in preference to lap windings because they are *not* "identical to" the latter in any respect except the number of paths. Again, on page 105, "For wave windings, whether series or series-parallel, . . . . . there are required but two brush sets, whatever the number of poles." This is not correct with respect to series-parallel or simple multi-path wave windings, which invariably require more than two sets or rows of brushes. The discussion on page 108 of the choice of the number of armature circuits is highly general in character, and reads as though the author had tried to frame a general mode of procedure from consideration of a single actual machine. This unsatisfying characteristic crops out at intervals all through the book. For example, on page 147: "Assume a suitable value for the Steinmetz coefficient. . . . . Taking 3.13," etc. Why 3.13? And how is one to know what is a "suitable" value for a coefficient that ranges from 1.4 to 4.75, when calculating a single design with no precedent? Again, on page 153, after fixing on ½ inch as the proper air-gap (by some criterion not explained) the author says "unless there is some reason to the contrary, it would with advantage be larger so we will adopt 0.65 inch." Why need it be larger? And if so, why 0.65? Why not ⅝ or anything else? This sort of "designing" is academic to a high degree.

Taken all in all, the book is most commendable for the student and for designers who are sufficiently experienced to exercise discrimination. It contains many valuable charts and tables as well as complete details of a goodly number of representative dynamo designs, and after one has blue-penciled the inaccuracies and academic sections, the remainder is well worth many times the price of the book.

ELEKTRO-INGENIEUR KALENDER, 1903. By Arthur H. Hirsch and Franz Wilkins. Berlin: Oscar Coblentz. 287 pages, illustrated. Price, 2.50 marks.

This is the 1903 edition of a convenient little pocketbook—one that can really be carried in the pocket. The first section contains a calendar for the year, a table of squares, cubes, square and cube roots, logarithms, reciprocals, $\pi$ and $\frac{\pi}{1} \times n^2$ values for whole numbers from 1 to 1,000; a comparative schedule of the metric, old Prussian, Austrian, English, Russian and Swedish systems of weights and measures; numerous tables of engineering data, such as specific gravities and weights of materials, specific heat values, etc. The remainder of the contents is divided into fifteen sections, the subjects of which include the various forms of prime movers, electric lighting and power circuits, mediums of illumination, dynamos, motors, transformers, generating and sub-stations, and comparative cost of installing and operating gas and electric motors. Each section abounds with tables which facilitate the reader's search for information. There are also two sets of blank pages for memoranda, wire-stitched, which may be held within the covers of the book by means of an elastic cord, secured to the binding for that purpose.

## Automobile Telephone Truck.

At the recent automobile show in New York City an exhibit of special interest to electrical men was the traveling electric windlass for use in drawing telephone cables in and out of underground conduits. The New York Telephone Company is now utilizing this truck in regular daily service with the most satisfactory results. An illustration of the truck is shown herewith.

The vehicle measures 7 ft. x 16 ft. over all, the wheels being under the body of the truck. The total weight is four and one-half tons, of which 2,800 pounds is battery. The truck is guaranteed to transport a load of five tons fifteen miles and supply power for the operation of the cable-hauling machinery for three continuous hours, all on one charge of the battery. The one charge will carry the maximum load twenty-five miles when the cable-hauling machinery is not used.

AUTOMOBILE TELEPHONE TRUCK.

The upright device shown in front of the vehicle is designed to be let down into man-holes. It is built up from two channel bars, and when it is dropped into a man-hole the lower end is firmly braced so as to afford a rigid support for the pulleys over which the hauling cable runs.

The cable drum is located under the driver's seat. It is driven by a 2½-hp motor through reduction gear and has six speeds varying between 10 and 40 ft. of cable per minute. The vehicle is propelled by two 3-hp General Electric motors of the automobile type connected to the rear wheels through reducing pinions. The control is of the standard type and gives four speeds ahead and two backward.

The battery equipment is carried in a box underneath the body of the truck, and consists of 44 "Exide" cells having a capacity of 200 amp-hours and weighing, as already stated, 2,800 pounds. The truck equipment includes portable electric lights for the lighting of man-holes, etc., while the men are at work.

The vehicle is kept in order, and the batteries are charged daily, by the Rainier Company, general sales agent for the Vehicle Equipment Company, which built the truck. It has proved to be very economical in actual service and does the work of two gangs of men operating under the old method. When it is not used on cable work, it becomes available for trucking. In this capacity it does the work of three ordinary 2-horse trucks and much more expeditiously. With the power windlass available at all times, reels of cable can be loaded on to the truck quickly and deliveries made in much shorter time than where the work is done entirely by manual labor. As to the economy it may be stated that in cable work it costs the telephone company $37 per day for the operation of the truck, whereas the same labor performed by man power, in the old way, cost $69 per day.

## Westinghouse Motors for the New York Subway.

As has been previously announced, the Interborough Rapid Transit Company has divided the order for motors to be used on subway cars between the Westinghouse and General Electric Companies, each company to supply 340 motors. The subway company will operate two classes of train service. The first will consist of five-car local trains, composed of three motor cars and two trailers, making an average speed of approximately 16 miles per hour. The second will be eight-car express trains, comprising five motor cars and three trailers, and the requirements of the franchise include the maintenance of an average speed of 30 miles per hour. The same motors and gearing will be used for both classes of service. Each motor car will be equipped with two motors of 200 hp each. The present motors are said to be of smaller size for their output than any ever built heretofore.

These motors are of the heavy railway type, similar in general appearance to the well-known standard Westinghouse railway motor. They will be supported on the truck by nose suspension. The normal capacity of the motor is 300 amp at 570 volts, or 200 hp for one hour. With this current and voltage a tractive effort of 4,150 lbs. is developed at the periphery of a 33-in wheel, at a speed of 19 miles per hour. Although designed for an average voltage of 570, the motor will operate satisfactorily with voltages up to 625. It will carry loads up to 500 amp without injurious sparking.

The motor has a field frame of cast-steel, divided into halves on the line of the centers of armature and axle, and completely surrounding the axle. There are thus no separate axle-bearing caps, and the number of pieces is consequently reduced to the least number possible for an easily accessible motor. The two halves of the field are held together by eight bolts, and by removing these the top half of the field can be readily lifted off and access gained to the interior for inspection, repairs or the removal of the armature or field coils. When the top field is removed the lower half remains suspended from the axle by stirrups, which are permanently attached to the axle bearings.

The four-pole pieces are made of laminated steel punchings, held between heavy end plates and secured by rivets. Each pole piece is bolted to the field frame by three bolts. These bolts do not pass through the pole pieces but terminate in a long nut inside, thus affording a smooth unbroken surface and absolutely rigid poles.

The field coils are made of copper strap wound on edge. All four coils are exactly alike in form and in number of turns. The insulation between turns consists of asbestos and mica, held in place by shellac and baked at a high temperature under heavy pressure, so that the coil and insulation make a solid mass. The completed coil is sealed in a curved metal case, from which it is insulated by molded mica made like the V-rings of a commutator. This construction gives a coil which is absolutely fire-proof, moisture-proof and practically indestructible. Each coil is held in place by the metal case or shell, which is securely bolted to the frame.

The armature is 20 in. in diameter and weighs 1,930 lbs. It is of the slotted-drum type, and is composed of sheet steel punchings assembled on a cast-iron spider. The commutator is also carried on the same spider and shaft and may thus be removed and replaced,

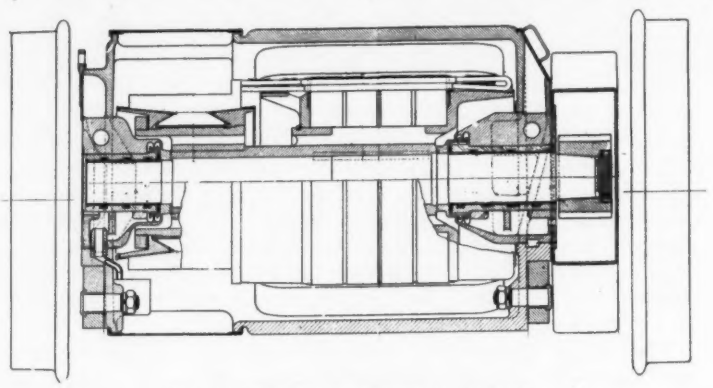


FIG. 1.—VERTICAL SECTION OF MOTOR.

should this ever become necessary, without disturbing the armature winding or its connection to the commutator. The winding is of the two-circuit type, and is of ventilated construction. There are 53 slots and 159 coils, i. e., three coils per slot. Each coil consists of a single turn of copper strap. The three coils which rest in each armature slot are formed and insulated before being put in place. They are placed in the slots without bending or hammering, and are carefully insulated from each other and from the core. Each conductor is continuous between commutator bars, thus giving minimum resistance and allowing the most effective insulation on all parts of the conductor.

The coils are held in the slots by wedges of special unshrinkable material, which will withstand a high degree of heat without injury. This greatly facilitates the removal and replacing of the armature coils. The armature insulation consists essentially of mica, which extends between turns at all points. The mica is protected by a sufficient amount of fibrous material to insure against deterioration.

The commutator is composed of 159 rolled and hard-drawn copper bars. These bars have solid necks raised above the surface of the commutator with milled slots, into which the armature bars are tightly soldered. The bars are mounted on a cast-iron spider and held in place by two steel V-shaped rings, one of which serves as an oil guard thoroughly to protect the mica from oil or grease. A low voltage between the commutator bars is secured, decreasing the

liability of flashing from any cause. The bars are insulated from each other by sheets of mica of a hardness that insures its wearing at the same rate as copper. The mica separating the bars from the rings is 1-16 in. thick, and the mica ring also separates the bars from the commutator spider. The wearing surface of the commutator is 16⅞ in. in diameter and 9⅞ in. long. The bars are of a depth which allows a reduction in diameter of 2 in.

The brush holders consist of two cast-brass arms, each secured independently to the commutator end of the upper frame casting by a special vulcabeston-headed bolt. The arms and bolts are insulated from the frame by fuller-board and mica bushings.

Each arm carries three carbon brushes, ⅝ in. x 3 in. in sections. The brushes slide over finished surfaces and each is pressed on

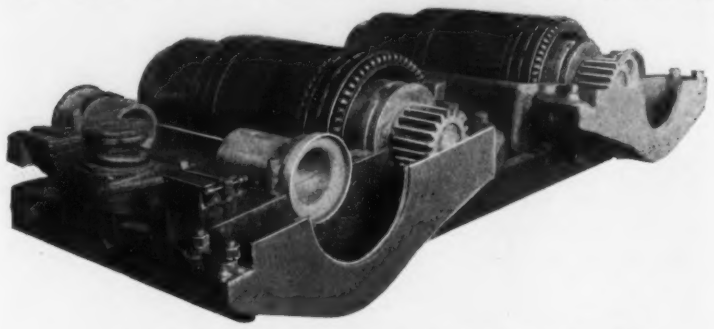


FIG. 2.—VIEW OF MOTORS WITH GEAR CASING REMOVED.

the commutator by a spring finger. The tension of these fingers is readily adjustable and the brush-holder arm is arranged for radial adjustment to allow for wear of the commutator. Copper clips are bolted to the carbon, and these clips are connected by flexible shunts, of ample capacity, to the body of the brush-holder, thus relieving the springs from carrying the current. By this arrangement each brush-holder can be easily removed through the opening above the commutator by loosening a single bolt.

Field and armature leads extend 5 ft. outside the motors, and are furnished with detachable connectors. The bottom field lead is brought out to the end of the lower field frame and carried up through a leader on the end of the upper field frame, avoiding necessity of disconnecting it when opening the motor.

The completed motor will stand an insulation test between winding and motor frame of 4,500 volts, alternating momentarily, or a test of 3,000 volts for one minute.

The armature bearings are contained in housings, which are securely held between the halves of the field frame, being tongued and grooved to the frame and accurately boweled. At the pinion end the bearing is 4¼ in. x 10 in., and at the commutator end 4 in. x 7 in. These bearings are provided with drip grooves, into which oil is thrown by wiper rings on the shaft. The bearing boxes are

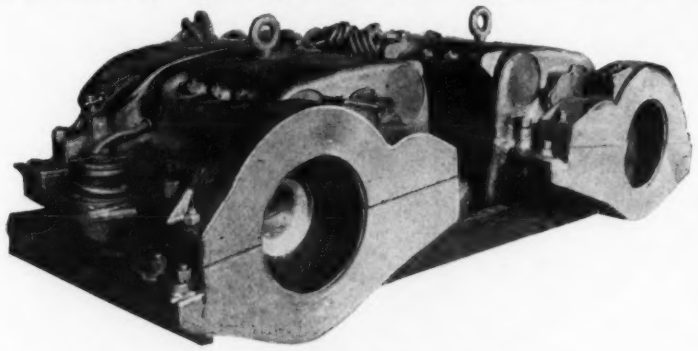


FIG. 3.—VIEW OF MOTORS COMPLETELY ENCLOSED.

of phosphor bronze, lined with babbitt metal well grooved for oil. The axle boxes are made to suit a 6½-in. axle and are 12 in. long.

Armature and axle bearings are lubricated by oil fed to the journals by waste, in accordance with standard railway practice. The oil boxes are formed so that the waste will pack itself against the journals. The oil box covers are lipped and hinged, and fitted with springs that keep the lids tightly closed or hold them open as desired. Drip boxes are provided to catch all waste oil so that no oil can get into the motor.

The gears are solid, of cast-steel, with cut teeth. The diametrical pitch is 2½ per inch, and the face is 5 in. The pinions are forged steel with cut teeth. They are taper bored to fit the shaft and are held in place by a nut and lock washer. The diameter of the shaft at the large end of the taper is 4⅜ in.

The gear case is made of malleable iron planed to a tight joint, with a suitable opening at top, having a hinged cover. It is supported at the ends by horns cast on the motor frame, and so shaped that they support the gear case without side strain, the weight being carried on its own plane. The whole motor can be dismantled with great ease and dispatch without the use of any special tools. The total weight of motor, gear, gear case, etc., is about 6,600 lbs.

## Bullock Apparatus.

The accompanying illustrations show some of the more interesting type of alternating-current machines recently installed by the Bullock Electric Manufacturing Company. Fig. 1 represents the stationary armature of a 1,500-kw. three-phase generator operating at 100 r.p.m., and built for the Denver Gas & Electric Company. This machine is designed for 2,400 volts at 60 cycles. The generator is of a flywheel type, the poles being put directly on the rim of the flywheel. The inside diameter of the armature is 18 ft., the outside diameter being 23 ft. The armature is bar-wound, with two conductors per slot, each conductor consisting of three strips in order to prevent eddy currents in the bars.

The largest belted alternating-current generators built in recent

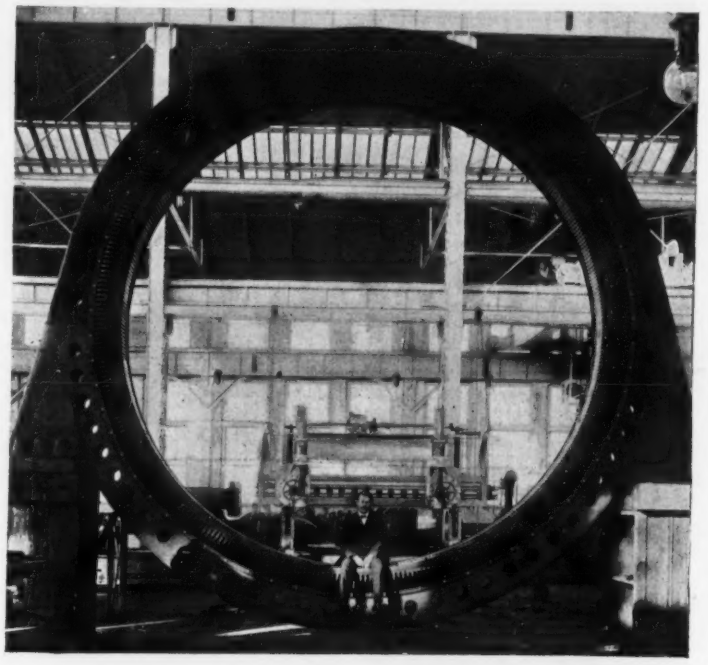


FIG. 1.—ARMATURE FRAME 1,500-KW GENERATOR, DENVER GAS & ELECTRIC COMPANY.

years have also been installed by the Bullock Company in Denver. They are 600-kw. three-phase generators, having 18 poles and running at 400 r.p.m., generating 2,400 volts at 60 cycles. The inside diameter of these machines is 75½ inches. The peripheral speed is, therefore, approximately 8,000 ft. per minute. Owing to this high peripheral speed, and the very narrow armature, these machines can stand tremendous overloads without undue heating, the temperature rise at full normal load hardly exceeding 20 degs. C. in any part of the machine.

Fig. 2 shows an armature of 600-kw. three-phase synchronous motor operating on a 4,500-volt circuit at 60 cycles and 450 r.p.m. The peripheral speed of this machine is also very high, viz., 7,700 ft. per minute. The synchronous motors are direct connected to 300-volt direct-current generators to operate on an Edison three-wire system.

Fig. 3 shows a 1,000-kw., 30-cycle synchronous motor for 2,300 volts and 450 r.p.m. The photograph of this machine was taken in the testing room of the Bullock Company. The motor is one of four built for the Shawinigan Water & Power Company, and installed at Maisonneuve, Montreal. The motors receive current from the Shawinigan power house after two transformations. The Shawinigan Water & Power Company's station is at a distance of

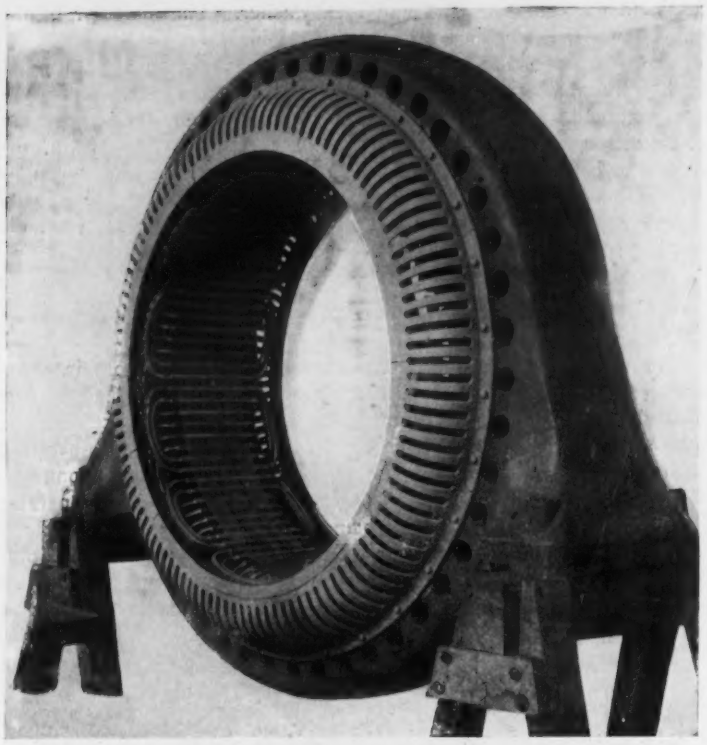


FIG. 2.—ARMATURE OF 600-KW, 3-PHASE MOTOR.

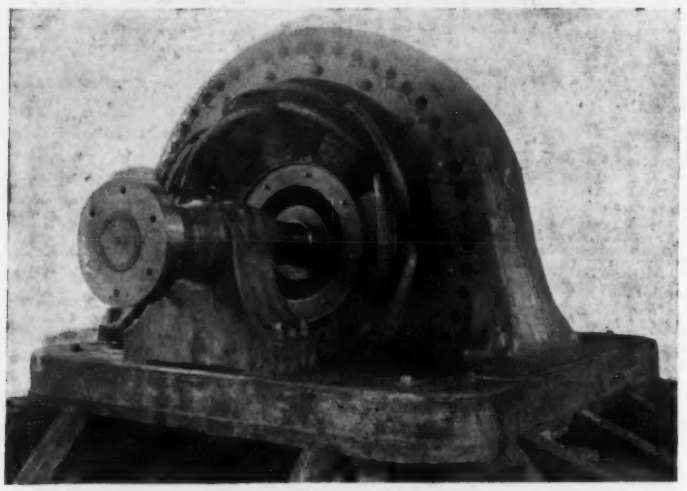


FIG. 3.—1,000-KW SYNCHRONOUS MOTOR FOR FREQUENCY CHANGERS, SHAWINIGAN COMPANY, MONTREAL.

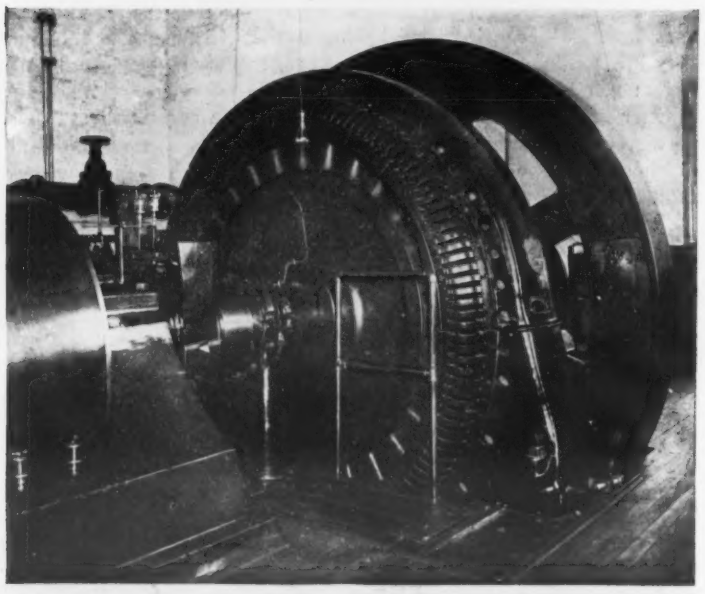


FIG. 4.—450-KW, 3-PHASE GENERATOR, SHELBYVILLE, IND.

85 miles from Montreal, the power being transmitted at 50,000 volts over three aluminum cables, being stepped down to 2,300 volts at Montreal. The current is then changed by the four 1,000-kw. frequency changers from 30 cycles to 60 cycles. The 60-cycle ends of these frequency changers are operating in parallel with the 60-cycle circuits of the Lachine Hydraulic Land & Water Power Company. The plant was put in operation in Fegruary, 1903. The field coils of these motors are made of copper strip on edge, 1 inch by 1-16 inch, and are perhaps the largest strip coils ever made, their outside dimensions being 21 inches by 15 inches.

Fig. 4 represents a 450-kw., 26-cycle, three-phase generator for

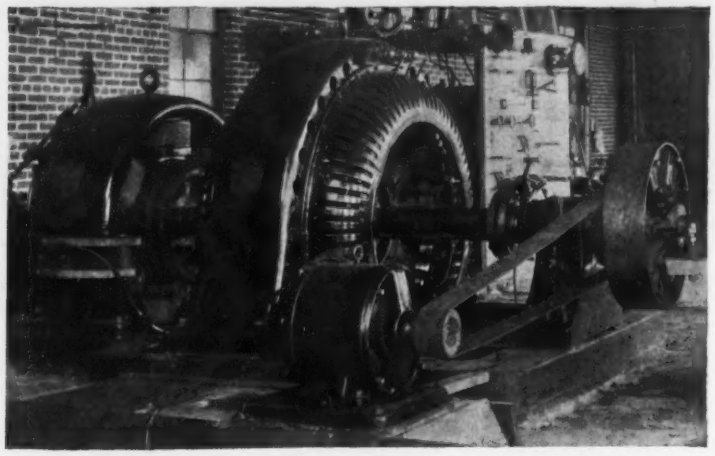


FIG. 5.—200-KW SYNCHRONOUS MOTOR, SAN BERNARDINO.

400 volts at 114 r. p. m. This machine is operating two 250-kw. Bullock rotaries for the Indianapolis, Shelbyville & Southeastern Railroad Company. The generator has nine slots per pole, there being two conductors per slot. The winding is a bar-winding provided with excellent ventilation. The generator is direct-connected to an Atlas engine. This plant has been in operation for almost a year, and in spite of the sudden variations in load, there have been no signs of hunting in the rotary converters, a fact which is doubtless due to the careful design of both the generator and rotaries.

Two years ago the Bullock Company designed a 200-kw. motor-generator set, operating at 500 r. p. m. on the 11,000-volt, 50-cycle circuit of the Los Angeles Edison Company at San Bernardino, Cal. This machine, shown in Fig. 5, has 12 poles, and is perhaps one of the smallest units designed to operate directly on so high a potential as 11,000 volts. It is direct-connected to a direct-current railway generator.

## Annual Report of Electric Storage Battery Company.

The annual meeting of the Electric Storage Battery Company, at which 138,539 shares of stock (out of about 160,000 outstanding) re-elected P. A. B. Widener, Wm. L. Elkins, Thomas Dolan, George D. Widener, Rudolph Ellis, Grant B. Schley, George Philler, Thomas J. Regan and Herbert Lloyd directors, and ratified the sale of the Derby Lead property and the purchase of Chloride Electrical Storage Battery Company, Limited, of England.

President Lloyd denied the newspaper reports of the last six months by stating that no agents of the General Electric Company had ever looked over the plant of the Electric Storage Battery Company and that the subject of the absorption of the Storage Company by General Electric had at no time been considered by the directors. He mentioned incidentally that the Storage Company during 1902 had done nearly 95 per cent. of the battery business of this country. It also transpired that the company owns about one-third of the stock and the same proportion of the bonds of the Pennsylvania Electric Vehicle Company.

The most important matter brought out at the meeting was the plans of the Storage Battery Company for the development of the Chloride Electrical Storage Battery Company, Limited, of England, which has been recently taken over. Control of the Chloride Storage Company, through the acquisition of 44,000 shares of stock, was purchased last October for about $298,000 cash. A new board of directors has since been elected, a majority of whom represent the

American Storage Battery Company. Last November several experts were sent over to Americanize the English works which are at Manchester, and this work is now under way. It is also proposed to reorganize the business department of the works. The Chloride Company is said to have paid 8 per cent. to the stockholders for a number of years. We are advised that the battery manufactured by the Chloride Company under an English patent is practically identical with that produced by the American Electric Storage Battery Company. The Chloride Company has already worked up a market in the British colonies, but it is the purpose of the American management to reach out on a large scale for new business in Mexico and South America, pushing the business side from Philadelphia, but shipping the Manchester product, which can go considerably cheaper to those points than the batteries manufactured in Philadelphia.

It is given out officially that the Derby Lead property, which was bought in 1900 for about $275,000, involved neither profit or loss to the company, the difference between the above amount and $542,282, the selling price, representing the money actually put out on the property by the Storage Battery Company. The annual report

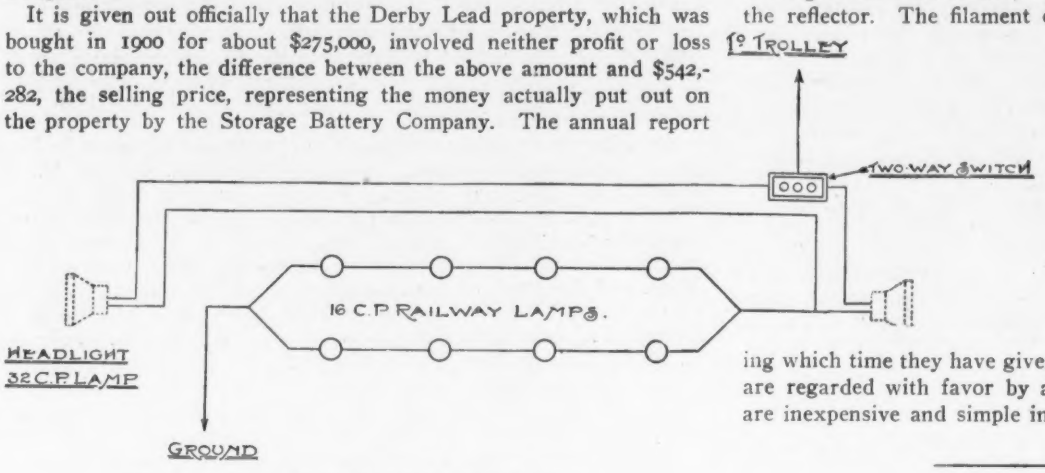



FIG. 1.—WIRING CONNECTIONS FOR HEADLIGHT.

for the fiscal year ended December 31, 1902, compares as follows:

| | 1902 | 1901. | Changes. |
|---|---|---|---|
| Net earnings | $1,113,199 | $900,242 | Inc. $212,957 |
| Less dividends | 812,427 | 812,413 | Inc. 14 |
| Surplus | $300,772 | $87,829 | Inc. $212,943 |
| Previous surplus | 2,022,582 | 1,934,753 | Inc. 87,829 |
| Total surplus | $2,323,354 | $2,022,582 | Inc. $300,772 |

## Incandescent Lamps for Street Car Headlights.

With the growth of urban trolley lines and the high speeds of modern street railway service, effective headlights are a necessity.

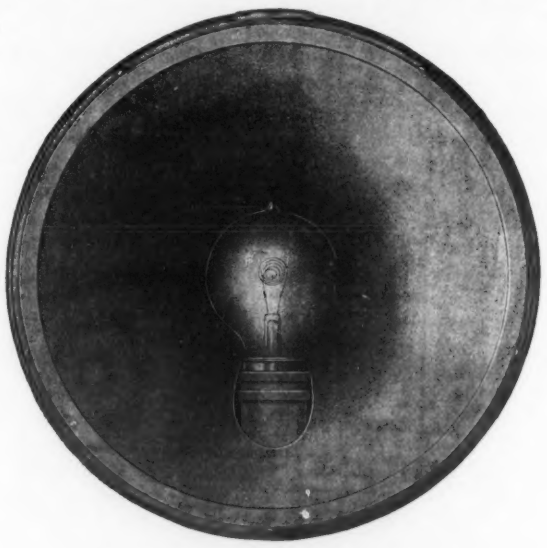


FIG. 2.—STREET CAR HEADLIGHT.

To be effective for such service a headlight must throw a brilliant path of light for a distance of at least one hundred feet ahead of the car. When using a parabolic reflector for projecting the light, the filament of the incandescent lamp should be compactly formed so as to concentrate the light as far as possible at the focus of the reflector.

The General Electric Company is producing a lamp with a special filament, wound in the form of a close conical spiral, which serves this purpose admirably. This filament is supplied in several types of bulbs made to fit the various types of headlights. The standard type of headlight lamp is the round bulb 32-cp size here illustrated. This requires the headlights to be wired in multiple series connection with two circuits each of four 16-cp lamps. The wiring connections are clearly illustrated in the accompanying diagram. For conditions which do not permit using a 32-cp lamp, a 16-cp lamp with a conical spiral filament is made. The larger lamp should, if possible, be used, as anything less does not give a sufficient volume of light for a good headlight service.

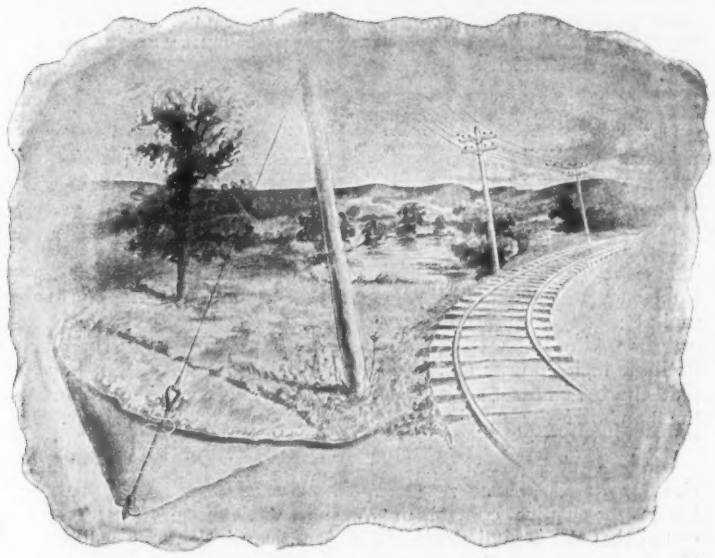
To give the best results, the lamp should be properly focussed in the reflector. The filament can be located at the proper height to place it in the focus line if the dimensions of headlight are stated. A plan, adopted by several companies with excellent results, is to make the socket in the headlight adjustable both vertically and laterally. By the movement of a pair of thumbscrews, this enables the motorman to focus the lamp positively and accurately.

These headlight lamps have been in use on a number of street railways for the past two or three years, during which time they have given thoroughly satisfactory service. They are regarded with favor by all roads that have tried them, as they are inexpensive and simple in their application and operation.

## Guy Anchors for Poles.

The accompanying illustration gives an idea of the action of Stombaugh guy anchors. At first glance it would appear that a six-in. anchor, for instance, would only have the resisting power as if a six-in. hole were dug and the anchors slipped into it and the hole filled and tamped. By referring to the cut a dotted spiral line will be noticed. This shows how the helix of the anchor worms its way in, so to speak. The ground is not disturbed any more than a wood screw tears a piece of board.

A second glance at the cuts shows a cone having the anchor point for its vertex. This conical section indicates the manner in which the lines of force work when the strain is placed on the anchor. It



GUY ANCHOR.

will readily be seen that the holding power of the anchor is represented by the cone and not by the spiral section. W. N. Matthews & Bro., Laclede Building, St. Louis, are placing these anchors on the market.

# NEWS OF THE WEEK.

## Financial Intelligence.

THE WEEK IN WALL STREET.—Money was freely offered by brokers and there was a fair demand, the closing rates being 5¾ a 6 per cent. for 30 to 90 days, and 5¼ a 5½ for four, five and six months. In the stock market there was moderate activity and increasing strength, due to the more favorable money market conditions. Advances were general in the standard stocks, but short covering was the main source of the buying power. Industrial stocks, however, were not prominent, although the United Steel issues were steady. Amalgamated Copper was irregular on the recession in copper prices. The traction stocks were rather quiet, although a good deal of strength was shown in connection with Manhattan and later on in Metropolitan Street Railway shares. The latter made a net gain of 5 points, closing at 138¾, the highest figure of the week being 140 and the lowest 132¾. The shares sold aggregated 60,350. Brooklyn Rapid Transit closed at 67½, thereby making a net gain of 2¼ points. This stock fluctuated between 64 and 68, and 34,900 shares changed hands. Greater strength was shown in the electrics, General Electric closing at the highest figure of the week, namely, 196¾, ex div., being a net gain of 5¼ points. Westinghouse made a net gain of 6 points, closing at 208, which was also the highest figure of the week. Western Union made a gain of ¼ point, closing at 88¾, ex div. American Telephone & Telegraph was the exception, receding 3½ points on the week's business, 164¾ being the quotation throughout the week. American Telegraph & Cable is quoted at 82, being a net loss of ¼ point. On the Boston market General Electric advanced 3½ points and American Telephone & Telegraph was off ½ point. Following are the New York closing quotations of March 24:

NEW YORK.

| | Mar. 17. | Mar. 24 | | Mar. 17. | Mar. 24 |
|---|---|---|---|---|---|
| American Tel. & Cable | 80 | 82 | General Electric | 192 | 192⅞ |
| American Tel. & Tel. | 164¾ | 163¾ | Hudson River Tel. | .. | .. |
| American Dist. Tel. | 37 | 35 | Metropolitan St. Ry. | 133¾ | 134¾ |
| Brooklyn Rapid Transit | 64⅝ | 65¾ | N. E. Elec. Veh. Trns. | .. | ⅛ |
| Commercial Cable. | .. | .. | N. Y. & N. J. Tel. | .. | 164 |
| Electric Boat | 20 | 27 | N. Y. E. V. T. Co. | 8¾ | 9¼ |
| Electric Boat pfd. | 35 | 40 | Tel. & Tel. Co. Am | .. | .. |
| Electric Lead Reduction | 2⅜ | 2⅝ | Western Union Tel. | 89⅜ | 88 |
| Electric Vehicle | 8½ | 8⅛ | Westinghouse com. | 205 | 205 |
| Electric Vehicle pfd. | 14⅛ | 14 | Westinghouse pfd. | 218* | 200 |

BOSTON.

| | Mar. 17. | Mar. 24 | | Mar. 17. | Mar. 24 |
|---|---|---|---|---|---|
| American Tel. & Tel | 165 | 164 | Western Tel. & Tel. pfd. | 99 | 98½ |
| Cumberland Telephone | .. | .. | Mexican Telephone | 2⅛ | 2¼ |
| Edison Elec. Illum. | .. | .. | New England Telephone | 138 | 138⅛ |
| General Electric | .. | .. | Westinghouse | 100 | 102 |
| Western Tel. & Tel. | 22 | 22 | Westinghouse pfd. | 100 | .. |

PHILADELPHIA.

| | Mar. 17. | Mar. 24 | | Mar. 17. | Mar. 24 |
|---|---|---|---|---|---|
| American Railways | .. | .. | Phila. Traction | 97¼ | 97¼ |
| Elec. Storage Battery | 76⅛ | 77† | Phila. Electric | 7⅛ | 6⅞ |
| Elec. Storage Battery pfd. | .. | .. | Pa. Electric Vehicle | .. | .. |
| Elec. Co. of America. | 8⅞ | 9 | Pa. Electric Vehicle pfd | .. | .. |

CHICAGO.

| | Mar. 17. | Mar. 24 | | Mar. 17. | Mar. 24 |
|---|---|---|---|---|---|
| Central Union Tel. | .. | .. | National Carbon pfd. | 99 | 98⅝ |
| Chicago Edison | .. | .. | Northwest Elev. com. | .. | .. |
| Chicago City Ry. | 210 | 212 | Union Traction | 9¼ | 9¼ |
| Chicago Tel. Co. | .. | .. | Union Traction pfd. | 42 | 42 |
| National Carbon | 24¼ | 24¼ | | | |

*Asked. †Ex Dividend.

BELL TELEPHONE FINANCES.—In a recent statement or interview, President Fish, of the American Telephone & Telegraph Company, in speaking of the proposal to increase the authorized capital stock from $150,000,000 to $250,000,000, said that the company is taking this step because at present it has theoretically reached its limit in its power to issue stock. This does not mean, however, that there is now $150,000,000 stock outstanding. The amount in the hands of the public is $109,685,000 stock. Besides this, about $27,100,000 more is held in the treasury of the old Bell Company, leaving about $13,200,000 of authorized stock still unissued. In a circular dated January, 1902, offering for subscription $10,000,000 bonds to acquire control of Western Telephone, President Fish stated that the capital stock of the American Telephone & Telegraph Company was $114,858,400, of which there was outstanding in the hands of the public $82,748,000. The remainder was held in the old Bell treasury. Since that date there has been sold to stockholders at par $21,937,000 new stock, making the total capital stock issued $136,795,400, of which $104,685,000 was outstanding. It is also understood that $5,000,000 of the stock in the Bell treasury was sold privately to New York parties now represented in the directory. This would make the total stock outstanding in the hands of the public at present $109,685,000. The statement that the company is at present theoretically limited in its stock issue is taken to mean that the treasury stock is regarded as issued. As there is only $13,200,000 stock still unissued, it is clear that if the company intends to issue as much stock for construction this year as it did last year, i. e., almost $22,000,000, it must either sell the stock in the Bell treasury or increase the amount of capital stock authorized. The stock sold represents the share that the parent company has to put up as a partner in its growing sub-companies.

MEMPHIS (TENN.) LIGHTING MERGER.—The Memphis Consolidated Gas & Electric Company is to be the name of the new concern under which the merger of the Equitable Gas Company and the Memphis Light & Power Company is being effected. It has a capital stock of $4,000,000, $2,000,000 of which is paid in in stock of the companies consolidated. The charter will be filed this week, with the deeds of transfer. The charter was taken out in New Jersey by New York men, including William P. Martin, T. M. Gunderson and John Richey. The transfer was made in New York several weeks ago when Frank G. Jones, president of the Equitable Gas Light Company, and General S. T. Carnes, acting president of the Memphis Light & Power Company, were in New York, and the stock of the two old companies is now in the hands of the Central Trust Company, of New York City. The Board of Directors of the new company is as follows: Anthony N. Brady and C. K. G. Billings, New York; George O. Knapp, president People's Gas Company, Chicago; James Maher, Frank G. Jones and General S. T. Carnes. The New Yorkers hold the bulk of the stock and will, therefore, direct the future policy of the company. The old companies have franchises for 35 years. In consideration of the privilege of merging the two interests a reduction of $90,000 per year in the public charges for lights was agreed upon, besides furnishing a large amount of lighting to the city free. The new company has the right to own and operate lighting plants in other cities with its authorized capital of $4,000,000.

OTIS ELEVATOR COMMON.—The directors of the Otis Elevator Company have declared an initial dividend of 2 per cent. on the company's common stock. The company was incorporated in November, 1898, and a dividend of 1½ per cent. has been paid quarterly on its preferred shares. In September last the authorized amount of preferred stock was increased from $4,500,000 to $6,500,000. The authorized amount of common stock is also $6,500,000, of which $6,350,000 is outstanding. In the year covered by the forthcoming annual report the expansion of the company's business has continued. The plants in operation were worked to their full capacity here and abroad. The company strengthened its position by the purchase of the business of R. Waygood & Co., the leading British manufacturers of elevators, and extended its trade in Canada, by the purchase of plants at Hamilton, Ontario, and Montreal, Quebec. The duty on Otis elevators imported into Canada made the importation of them unprofitable and cut off an expanding business field.

POWER DEAL AT MONTREAL.—It is announced that the Montreal Light, Heat & Power Company has sold to the Bank of Montreal and Messrs. N. W. Harris & Co., bankers of New York city, an issue of $4,000,000 thirty-year 5 per cent. bonds to pay in part for the Lachine Rapids Hydraulic & Land Company, Limited, and its two affiliated companies, i. e., the Standard Light, Heat & Power and the Citizens' Light, Heat & Power Company. The new bonds will be the obligation of the Montreal Light, Heat & Power Company, and will be additionally secured by a lien on all newly acquired properties. The capital stock of the company will be $17,000,000. This makes a consolidation of all the electric power interests at Montreal.

BULLOCK COMPANY MEETING.—The annual meeting of the stockholders of the Bullock Electric Company was held at the office of the company, in Norwood, Ohio, last week. The reports of the officers showed that the business during the past year was exceptionally good and that there are now orders enough on hand to keep the plant in full operation for the next six months. The old officers and directors were re-elected: George Bullock, president; J. S. Neave, vice-president; R. T. Lozier, second vice-president; Stephen R. Burton, treasurer; secretary, J. W. Bullock; W. S. Rowe and J. B. Dill, of New York, additional directors. The company is capitalized at $2,000,000.

ROCHESTER GAS & ELECTRIC.—The Rochester, N. Y., Gas and Electric Company last week filed with the Secretary of State a certificate increasing its capital stock from $4,300,000 to $5,000,000.

LACLEDE POWER COMPANY.—The Laclede Power Company, at a recent meeting of its directors in St. Louis decided to increase its capital stock from $800,000 to $2,000,000. The proposition will be laid before the stockholders at a special meeting on May 18. Business of the company has increased to such an extent that the directors found it necessary to adopt plans for increasing the capacity of its plant. The plant, located at Lewis and O'Fallon Streets, has now a capacity of about 3,000 kw. The increase will add an important factor to the local lighting and power situation. The company has a well-established business, which it will doubtless hold. The Laclede Power Company has not been included in any of the lighting and power consolidation rumors. The directors of the company, it is said, are in favor of running it as an independent concern. The directors are: Henry C. Scott, president; E. V. Matlack, manager; Samuel W. Fordyce, J. C. Van Blarcom and Thomas H. West.

EXPENDITURES AT BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has decided to continue its policy of physical improvements at Birmingham. President Robert Jemison says that the company will expend with the improvements already under way two and a half million dollars. The directors have authorized a meeting of the stockholders to consider the increase of the capital stock from $5,000,000 to $6,500,000. The present capital stock is $3,500,000 common and $1,500,000 preferred. The power plant at Birmingham is to have six new batteries of boilers and two more engines, giving the plant an increase of 3,000 hp. A new building 100 x 100 will be erected to hold the new machinery. The gas plant is to be increased one-third. The steam dummy line from Birmingham to Bessemer will be in operation as an electric line by April 1.

NEW YORK TICKER SERVICE.—The Gold & Stock Telegraph Company has advanced the price of Cotton Exchange tickers from $15 to $20 per month, to begin April 1, 1903. This advance it is understood has necessitated the re-application of each subscriber for the ticker, the application to be accompanied by "iron-clad contract" not to use or permit to be used a quotation for bucket shop purposes. It is understood that the contract is very similar to the Stock Exchange contract for use of tickers, Consolidated Exchange contract, the Chicago Board of Trade contract, and that of the Minneapolis Board of Trade. It is intimated that strict enforcement of the contract may result in the weeding out of a good many bucket shops.

ELECTRIC POWER IN MASSACHUSETTS.—Electric power is to be developed on the Farmington River, between the towns of Tolland and Sandsfield, which will furnish power to light cities and towns and run trolleys all over the Berkshires and as far east as Springfield, Mass. New York and Boston capitalists support the venture, on which they are to spend at least $500,000. A great reservoir is to be built on the farm of Cebra Haley, in Sandsfield, and the water will be conveyed four miles to Sandsfield Centre, where a generating plant, of 6,000 hp, will be located. The G. L. Straw Company, of Boston, has obtained options on farms in the section, which is the wildest part of the Berkshires.

UNITED ELECTRIC OF NEW JERSEY.—At the annual meeting of the United Electric Company of New Jersey, in Newark, it was announced that the gross receipts for the year were $1,854,304.77; operating expenses, $1,110,041.40; net earnings, $744,263.37; interest on bonds, $698,533.43; net profit over all charges, $45,729.94. Included in the operating expenses is the sum of $68,945.36 for coal, in excess of contract prices, owing to the coal strike.

MARYLAND TELEPHONE & TELEGRAPH CO.—The Maryland Telephone & Telegraph Co. has filed a general mortgage at Baltimore in favor of the Central Trust Company to secure the issue of $4,000,000 of 50-year 5 per cent. gold bonds. The company's charter authorizes it to carry on an electric lighting business, and it is stated that it is likely that the company will avail itself of this authority.

NORTH AMERICAN COMPANY.—At the special meeting of the stockholders of the North American Company it was voted to increase the capital stock from $12,000,000 to $17,000,000. The increase of $5,000,000 has been made for the purpose of paying for the stock of the Laclede Gas Company, of St. Louis, and whatever amount is issued will be offered to stockholders at par.

DIVIDENDS.—The directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent. The Cumberland Telephone & Telegraph Company has declared the regular quarterly dividend of 1¾ per cent., payable April 1.

KINGS COUNTY LIGHTING.—The stockholders of Kings County Electric Light & Power Company, of Brooklyn, N. Y., have voted to increase the capital stock from $2,500,000 to $5,000,000.

MEXICAN TELEPHONE shows for eleven months a net of $102,470, being an increase of $12,242; and 4,458 subscribers, being a gain of 563.

# Commercial Intelligence.

THE WEEK IN TRADE.—The reports received by the mercantile agencies continue to be generally favorable. Excessive moisture in the form of heavy rains and floods, or of merely bad roads is, according to *Bradstreet's*, an apparent drawback to distributive trade. To offset this, however, may be noted an improvement in jobbing trade at some leading Western centers; slightly improved collections; perceptible easing of the car shortage trouble and increased strength in the iron and steel trades. There is apparently some improvement in the labor situation, but labor disturbance is still a bad feature, particularly in the building trades. The higher cost of material and the very high wages of labor are undoubtedly also retarding influences at the present time. Railway earnings thus far available for March show an increase of 14.6 per cent. over last year, and 26.1 over 1901. In the metal market copper showed practically no change since our last report. Quotations are entirely nominal and producers say that Lake cannot be obtained under 15⅛c. Quotations are as follows: Lake and electrolytic, 14¾ a 15c.; casting stock, 14½ a 15c., and standard, 14c. The business failures for the week ending March 19, as reported by *Bradstreet's*, numbered 194, against 176 the previous week, and 197 the corresponding week last year.

GAS ENGINE ORDERS.—The advance of the gas engine is well illustrated in the installation now operating in the plants of the Riter-Conley Manufacturing Company, at Allegheny and Leetsdale, Pa., aggregating 1,600 hp in Westinghouse gas engines of the vertical single-acting type. Three of the engines are 280 hp and are direct-connected to polyphase generators arranged for parallel operation. These generators supply current for light and power in the new shops at Leetsdale, Pa. The remaining engines are employed for driving air compressors, pumps, etc. The gas engine is relied upon at both works for the entire power supply. A few other recent installations of a similar nature are: Potosina Electric Company, San Luis, Potosi, Mexico, 1,225-hp producer gas power plant, supplying the City of Mexico with electric light and power. Horizontal double-acting engines used, direct-connected to polyphase generators operating in parallel. Pittsburg Screw & Bolt Company, 245 hp for generator driving exclusive power supply. McClintock-Marshall Construction Company, Rankin, Pa., 585 hp for driving generator and compressors. Marshall Foundry Company, Pittsburg, Pa., 375 hp for generator driving to furnish power for entire works. Consolidated Gas Company, Long Branch, N. J., 608 hp for generator driving, combined gas and electric plant, producer gas used. North Baltimore (Ohio) Electric Light & Power Company, 250 hp, for driving lighting generators. Light and power plants at Sistersville, W. Va., and Hutchinson, Ky., 125 hp each, for generator driving. These installations are now under erection. The machinery was furnished by Westinghouse, Church, Kerr & Co.

STEAM TURBINES.—The total aggregate power of steam turbines in use or under construction or ordered in different parts of the world is put at over 500,000 hp. The major portion is used or to be used for the driving of dynamos. An item in point is the contract recently given to the British Westinghouse Electric & Manufacturing Company, Limited, by the Metropolitan District Railway Company, of London, England, for four turbo-alternators. Each of these is designed for a normal capacity of 5,500 kw, but will be capable of carrying an overload of 50 per cent., giving for each unit a maximum output of 8,250 kw, or about 11,000 hp. These will be not only the largest steam turbines ever made, but also the most powerful single-cylinder engines of any type whatever in the world. Very few multiple-cylinder engines have greater power. The engines are only 29 ft. in length by 14 ft. wide, by 12 ft. high, the overall length of turbine and alternator being 51 ft. 9 in. The steam pressure will be 165 lbs. per square inch, and the speed 1,000 r.p.m.

EXPORT OF AUTOMOBILES.—The United States Treasury Department's annual report on the commerce of the United States for the year ending June 30, 1902, gives the value of the exports of American-made automobiles for that period as $948,528. Of the total valuation given, all but $92,714 worth of machines were shipped from New York. The largest foreign buyer of American motor vehicles was the United Kingdom, whose purchases amounted to $671,553. France took about $60,000, showing that the automobile trade is not all one way, but that our machines are appreciated in the pioneer automobile country.

LONG ISLAND STONE-CUTTING PLANT.—The Westinghouse Electric & Manufacturing Company has taken a contract for a 100-kw generator, a 75-kw machine and 10 motors for installation in the stone-cutting plant at Ravenswood, L. I., operated by Senator W. A. Clark, of Montana. The engines, as already mentioned in these columns, will be built by the Harrisburg (Pa.) Foundry & Machine Works.

TELEPHONE SYSTEM FOR KANSAS CITY.—The contract for the central office equipment for the Home Telephone Company, Kansas City, Mo., and Kansas City, Kan., has been awarded to the Stromberg-Carlson Telephone Manufacturing Company. The contract comprises four exchanges as follows: The main exchange having a capacity for 12,000 lines will be equipped for the immediate operation of 4,500 lines, capacity for 360 trunk lines, present equipment of 120 lines. The east branch exchange will have an ultimate capacity of 7,200 lines, equipped for the immediate operation of 1,200 lines, capacity for 360 trunk lines and a present equipment of 75 lines. The south branch exchange will have a capacity for 7,200 lines and a present equipment of 700 lines, capacity for 360 trunk lines with a present equipment of 75 lines. The Kansas City (Kan.) exchange will have a capacity for 7,200 lines and will have a present equipment of 800 lines, capacity for 360 trunk lines and a present equipment of 80. All of the above boards are to be of the bridged multiple relay lamp signal central energy type. The contract also calls for the necessary wire chief's, monitor's, and chief operator's desks, distributing frames, lightning arresters, power plant, storage batteries and a complete central office equipment. The main exchange is to be in operation September 20, and the sub-exchanges in October and November.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "Chloride Accumulator," has recently closed several large contracts for the installation of storage batteries in connection with street railway work on the Pacific coast. The Los Angeles Railway Company has contracted for three batteries, two consisting of 264 cells having a capacity of 1,000 amp and one of 264 cells having a capacity of 2,000 amp. These batteries are to be operated in connection with differential boosters for the purpose of regulating the railway load and for reserve in any emergency which may arise due to the temporary shut down of machinery at the power house. The Pacific Electric Railroad has also contracted for a battery of "Chloride Accumulators" consisting of 264 elements of 1,000-amp capacity to be operated in connection with a differential booster for regulation, peak work and emergency use. Several batteries are now in process of installation for the following roads in the same section: The Oakland Transit Consolidated, the Los Angeles Pacific Railway and the North Shore Railroad.

ELECTROLYTIC COPPER.—Mr. Titus Ulke contributes to the *Engineering and Mining Journal* a review of the progress of electrolytic refining in 1902. He says the world's average daily production of electrolytic copper is about 883 short tons, of which 764 tons, or 86.5 per cent., are supplied by the United States. Of the balance of 119 tons daily production, or approximately 13.5 per cent., Great Britain furnished a little over 8.8 per cent., Germany about 2.75 per cent. and France a little over 1.6 per cent. The United States now produces annually at the enormous rate of 278,860 tons of electrolytic copper. The by-product recovered daily contains about 741,100 ounces silver and 948 ounces gold, which equals an annual output of over 27,000,000 ounces of silver, valued at nearly $13,000,000 and more than 250,000 ounces of gold valued at $5,167,500. There are now in active operation, or ready to be placed in commission, 33 electrolytic copper refineries in the world, not including the plant of the Osaka Electrolytic Refining Company, now being constructed at Osaka, Japan.

PAWLING & HARNISCHFEGER, crane and hoist builders, Milwaukee, Wis., expect to move from their present location on Clinton, Oregon, Barclay and South Water Streets to a new site just purchased on National and Thirty-eighth Avenues. The property acquired is nineteen and one-third acres, having a north and south frontage of 2,800 feet, and possessing ideal shipping facilities through adjoining the belt line of the Chicago, Milwaukee & St. Paul, and the Chicago & Northwestern Railways. Work will at once commence on the new plant, which will be strictly modern and the best appointed that can be devised. Their plans at the present time are simply to increase their output by the additional buildings to be erected on the new site, although in time it is the intention to transfer their entire works to this new location.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has recently sold telephones—switchboards and supplies—to the following companies: Wataga Mutual Telephone Company, Wataga, Ill.; Gays Mutual Telephone Company, Gays, Ill.; Cullom Mutual Telephone Company, Cullom, Ill.; Fairbury Farmers' Telephone Company, Fairbury, Ill.; Millikan & Stokes Telephone Company, Edinburg, Ill.; Central Illinois Telephone & Telegraph Company, Lincoln, Ill.; Farmers' Mutual Telephone Company, Ashmore, Ill. The Stromberg-Carlson Telephone Manufacturing Company has also recently closed contracts for switchboards with the Bergholz Telephone Company, Bergholz, Ohio, and the Winona Telephone Company, Winona, Ohio.

ELECTRICAL IRRIGATION is coming to be widely used in the arid regions of the West and is transforming deserts into well cultivated and productive fields. The Consolidated Canal Company, of Mesa, Ariz., is arranging to furnish water for a large area and is installing in its power plant the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company: A 300-kw, three-phase, revolving-field alternator, running at 400 r.p.m. and 11,000 volts, which is direct coupled to a water wheel; also three 50-hp motors of 200 volts, 7,200 alternations, and 850 r.p.m., which will be used in operating irrigation pumps. All of this machinery has been shipped and is now being installed.

WIRELESS TELEGRAPH FOR PACKING HOUSES.—It is proposed to use the wireless telegraph system between Chicago and other live stock centers. If the scheme is found feasible Armour & Co. will effect an annual saving of almost $100,000. Tests will be made between Chicago and other Western cities, where the packing house has branches. Representatives of the De Forest Wireless Telegraph Company are to make the first experiment, which will be between the packing houses and the offices in the Home Insurance Building, in Chicago, a distance of seven miles. They will be conducted by Mr. White and Mr. Galbraith, agents of the company.

L. & N. SHOPS.—The new electrically-driven shops of the Louisville & Nashville Railroad, which are being built in South Louisville, Ky., will give employment, when they are completed, to 5,000 men and will have four times the capacity of the present shops and yard-houses of the road. The plant will cost $2,000,000. The improved machinery and electrical appliances which will be installed will permit a great increase in the capacity without the necessity of employing a proportionate number of men. The force of employees in the shop and yards will be doubled, however, and more than 2,000 new mechanics will be needed to operate the new plant.

LARGE CONTRACTS FOR CONDUIT.—Mr. G. M. Gest, the conduit contractor, has been awarded a large contract for the underground conduit work in and around the L Street Central Station of the Edison Electric Illuminating Company, of Boston, Mass. This construction will be very heavy, having 186 ducts in one trench. He has also just been awarded additional contracts by the Brooklyn Heights Railroad Company for underground conduit work along Flatbush Avenue, Brooklyn. This will be a large piece of work and will amount to many thousands of dollars.

AUTOMATIC TELEPHONE EXCHANGES.—The Automatic Electric Company, of Chicago, has received an order from the Delaware County Telephone Company, of Manchester, Iowa, for an automatic switchboard of 1,000 capacity with a present installation of 300 lines. Manchester has had automatic telephone service for seven years, the company being one of the early purchasers of automatic apparatus. The business has outgrown the ultimate capacity of the board now in use, and the new equipment was purchased to meet the increasing demands for service.

THE OTIS ELEVATOR COMPANY has been awarded a contract for eighten electric elevators equipped with the push-button system of control—the largest number of elevators of this type ever included in a single contract. These elevators are to be installed, one each, in a row of private residences now being constructed for F. Ambrose Clark on Seventy-fourth Street, between Central Park West and Columbus Avenue, New York.

BOILERS FOR RIO LIGHTING PLANT.—The electrical engineering and contracting firm of James Mitchell & Co., Rio de Janeiro, which represents several American manufacturers, has placed a contract with the Edward P. Hampson Company, 26 Cortlandt Street, for two high-pressure boilers for installation in a local electric lighting plant. The boilers are to be built by the Atlas Engine Works, Indianapolis, Ind.

ELECTRICAL EQUIPMENT FOR CEMENT PLANT.—Martin's Creek Portland Cement Company's plant at Easton, Pa., is to be electrically equipped. The C. & C. Electric Company have taken a contract for a 175-kw generator and four motors, representing an aggregate capacity of 220 hp. This equipment will be utilized for both light and power purposes.

BALL ENGINE CONTRACTS.—The Ball Engine Company, Erie, Pa., is building for the Dayton Arcade Company, Dayton, Ohio, a direct-connected unit. The Pennsylvania Company is installing in its Fourteenth Street station, Chicago, a 175-hp engine, furnished by the Ball Engine Company, which is direct-connected to a Westinghouse generator.

AFTER FORMOSAN LIGHTING PLANT CONTRACTS.—The British electrical engineering and contracting firm of L. J. Healing and Co., Yokohama, is after some substantial contracts for the equipment of Formosan lighting plants. The firm is represented in New York by Francis A. Cundill, whose offices are at 90 Wall Street.

WESTERN ELECTRIC COMPANY GROWTH.—The Western Electric Company has purchased 109 acres of land in Chicago upon which it will erect structures costing $1,200,000. The land was purchased for $313,000. The company has invested $3,000,000 in buildings at its present site.

# General News.

## THE TELEPHONE.

BOULDER, COL.—The Colorado Telephone Company will erect a new building here.

ATLANTA, GA.—The Southern Bell Telephone Company will soon establish a sub-station at West End to meet its necessary business requirements. A handsome building will be erected. The exchange will accommodate 1,000 subscribers. Cables have already been laid.

EL PASO, ILL.—The El Paso Telephone Company has increased its capital stock from $5,000 to $10,000.

DENVER, ILL.—McClintock Mutual Telephone Company, capital $2,400, has been incorporated by J. H. McClintock, Jas. A. Thompson and others.

GAYS, ILL.—The Gays Mutual Telephone Company has been incorporated with a capital stock of $2,400, by W. E. Storm, S. M. Lythe and A. W. Treat.

JOSLIN, ILL.—The Crescent Telephone Company has been incorporated with a capital stock of $12,500, by Daniel W. Mumms, John Butzer and A. W. Donahue.

WATSON, ILL.—The East Watson & Gilmore Rural Telephone Company, of Watson, has been incorporated with a capital stock of $1,000. The incorporators are E. W. Tucker, C. F. Bernhardt and V. C. White.

CHICAGO, ILL.—The Chicago Telephone Company installed during February nearly 1,200 new telephones, about 90 per cent. of these in residences and small stores. February would have shown a much larger increase had the weather permitted steady outside work. To date the orders on the books are fully 3,000 ahead of the company and applications are coming in from all parts of the city in large volume. Since the first of last October the company has installed 9,391 telephones and the gain in two years has been about 35,000. Altogether the company now has a few more than 63,000 telephones in service in the city and officials predict that with rapid work permitted during the summer months the 75,000 mark will have been easily attained by autumn.

SOUTH BEND, IND.—The New Market Telephone Company, of South Bend, has increased its capital stock from $1,000 to $2,000.

INDIANAPOLIS, IND.—The Fincastle Co-operative Telephone Company, of Putnam and Montgomery counties, has been incorporated with a capital stock of $420.

SANBORN, IA.—The Council has granted a franchise to the Citizens' Telephone Company.

SLATER, IA.—The Slater Telephone Company has been incorporated with a capital stock of $10,000.

LA MARS, IA.—The La Mars Telephone Company has been organized with a capital stock of $50,000.

TRACY, IA.—The Mutual Telephone Company has been organized here by Messrs. P. Heins, Frank Converse, L. Converse and others.

HORNICK, IA.—The Clark Automatic Telephone Company, of Sioux City, is seeking a franchise in this place. A vote on the subject will be taken on March 30.

DAVENPORT, IA.—The Iowa Telephone Company, it is stated, will expend $700,000 during the year in rebuilding and improving its old lines and building new ones.

DES MOINES, IA.—The North Branch Telephone Company, of Guthrie County, has been incorporated with a capital stock of $5,000. Mr. C. Cope is president and O. C. Parsons, secretary.

FARMERSBURG, IA.—The Wagner Telephone Company, of Farmersburg, has been incorporated with a capital stock of $1,500. Henry Walter is president and A. G. Kirshman secretary.

DES MOINES, IA.—The Luana & Monona Farmers' Telephone Company, of Clayton County, has been incorporated, the capital stock being $2,500. Mr. George Daubenberger is president and J. L. Eno secretary.

ATCHISON, KAN.—The Atchison Independent Telephone Association will build a toll line to Rushville and De Kalb and establish exchanges at both places.

PLYMOUTH, MASS.—The Old Colony Telephone Company has been incorporated in Maine with a capital stock of $35,000. The promoters are Anthony Atwood, Walter G. Loring and J. F. Waters.

KALAMAZOO, MICH.—It is stated that the Citizens' Telephone Company, recently organized in this city, has made an offer of $125,000 cash for the purchase of the Michigan Telephone Company's plant in Kalamazoo. The entire property of the Michigan Company, it is reported, will be sold under foreclosure. The Union Trust Company, of Detroit, it will be remembered, was recently appointed receiver of the Michigan Telephone Company.

WASECA, MINN.—The Waseca Telephone Company has increased its capital stock from $10,000 to $40,000.

EMMONS, MINN.—It is stated that the Farmers' Mutual Telephone Company will establish a local system here.

MORRISTOWN, MINN.—A telephone company has been organized here, Mr. H. W. Donaldson being secretary.

REDWOOD FALLS, MINN.—The Rural Telephone Company expects to build about 100 miles of line during the coming summer.

JACKSON, MINN.—The Jackson Telephone Company has absorbed the system of the Fairmount Telephone Company in this city and will extend and improve the same.

WINONA, MINN.—The Winona Telephone Company will make several extensions in the country districts. One line will connect Lewiston and Altura and another will be extended to Almon.

DULUTH, MINN.—The Zenith Telephone Company, of Duluth, proposes to purchase the Iron Range Telephone Company which now operates a system connecting Grand Rapids, Cass Lake, Bemidji and Crookston.

LEROY, MINN.—The Leroy Telephone Company has been incorporated with a capital stock of $100,000. The officers are: President, C. Mearcklein; vice-president, Fred Henslin; secretary, Charles J. Mearcklin; treasurer, A. Edgar Henslin.

ST. LOUIS, MO.—The Bell Telephone Company is preparing to establish a training school in this city for telephone operators. A small salary will be paid while the pupils are in training.

MILES CITY, MONT.—The Custer County Telephone line was recently sold by the sheriff. W. H. Harris, who holds a mortgage on the property, bid it in for $1,500. The original cost was $10,000.

LINCOLN, NEB.—The Western Union Independent Telephone Company, of Chicago, has been granted a franchise for an exchange in this place.

SILVER CREEK, NEB.—The Silver Creek Telephone Company has been organized with an authorized capital stock of $5,000. The following-named officers were elected: J. H. Pollard, president; Fred Johnston, secretary, and J. F. Gagen, treasurer.

JERSEY CITY, N. J.—The Illinois & Indiana Telephone & Telegraph Company has been incorporated here with a capital of $2,000,000, by Louis B. Dalley, Joseph W. Mitchell and Kenneth K. McLaren. According to newspaper reports this company is thought to be a part of the big independent system in the West that is gradually extending East and which is practically a part of the mammoth syndicate of which the Inter-State Company is a branch.

NORWOOD, N. Y.—The Norwood Telephone Company has been incorporated with a capital stock of $25,000. The directors are: W. J. Fletcher, F. L. Smith and A. C. Healey, Norwood.

NEW YORK, N. Y.—The New York & Northern Telephone & Telegraph Company has been incorporated with a capital stock of $50,000. The incorporators are Fletcher S. Hyatt, Jacob V. Jacobs and Charles E. Gardner.

ALBANY, N. Y.—The Albany District Telegraph Company has elected officers as follows: President, James H. Manning; vice-president and manager, F. W. Newman; secretary, W. B. Butler; treasurer, J. J. Fitzsimmons.

ALBANY, N. Y.—The Hudson River Telephone Company has elected directors and they in turn have elected officers as follows: President, James H. Manning; vice-president, Jeffries Wyman; secretary and auditor, Walter B. Butler; treasurer, James J. Fitzsimmons; general manager, Henry E. Hawley.

MARION, N. C.—The Marion Telephone Company has let a contract for a long distance line to Rutherfordton, N. C.

TEACHEYS, N. C.—The Teacheys Bell Telephone Company, of Teacheys, has been chartered with a capital stock of $5,000.

LIMA, OHIO.—The Lima Telephone & Telegraph Company has increased its capital stock from $150,000 to $200,000.

GENEVA, OHIO.—The directors of the Madison Telephone Company have authorized the expenditure of from $5,000 to $10,000 for improvements on the company's lines in Lake and Ashtabula counties.

EL RENO, OKLA.—Representatives of independent telephone companies in Oklahoma and the Indian Territory met in El Reno recently and formed an organization called the Oklahoma Independent Telephone Association. Twelve companies were represented at the meeting. The purpose of the organization is to further the development of and improve telephone service in the two territories.

MONMOUTH, ORE.—The Luckiamute Rural Telephone Company, of Monmouth, has been incorporated with a capital stock of $1,500. The incorporators are L. S. Perkins, H. R. Nehrbas, W. E. Williams, B. F. Smith and J. A. Withrow.

DOYLESTOWN, PA.—The Standard Telegraph & Telephone Company has completed plans for a number of extensions and improvements to its system in Doylestown and vicinity.

YORK, PA.—The York Eastern Telephone Company has been chartered to establish a system in the County of York. The capital stock is $8,000. The names of the incorporators are A. M. Grove, M. H. McCall, Henry S. Merryman, John H. Wilson, B. F. Norris, Joseph A. Gaily and Calvin M. Shaw.

HECLA, S. D.—The Hecla Telephone Company has been incorporated with a capital stock of $50,000.

WAUSAU, WIS.—The Wausau Telephone Company has purchased the property of the Wisconsin Bell Telephone Company in this city.

ALGOMA, WIS.—The Algoma Farmers' Telephone Company has been incorporated, with $500 capital, by Conrad R. Guth, Emil Miller, B. P. Churchill and Emil Maedke.

MT. HOREB, WIS.—The Interstate Telephone Company, of Mt. Horeb, has been incorporated by Martha E. Bell, Frank E. Bell and Lewis F. Heuer. The capital stock is $12,000.

WILTON, WIS.—The Ontario & Wilton Telephone Company has been incorporated with a capital stock of $5,000 by T. A. Surrurier, W. C. La Rue, F. M. Walker, J. H. Harland and F. P. Johnson.

SCHLEISINGERVILLE, WIS.—The Cedar Lake Telephone Company, of this place, has been incorporated with a capital stock of $2,000. The names of the incorporators are John Rosenheimer, John Rosenheimer, Jr., and Mary Rosenheimer.

RICHFIELD, WIS.—The Richfield, Hubertus & Holy Hill Telephone Company has been incorporated to establish a telephone system in Washington and Waukesha counties. The capital stock is $2,000, and the incorporators are H. Klippel, H. G. Meyers and Herbert Serres.

# ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—It is stated that the Birmingham Railway, Light & Power Company will expend about $2,500,000 in improvements.

FT. ROSECRANS, CAL.—Bids are wanted April 8 for the construction of a power house. Capt. Edgar Jadwin, Engineers' Corps, U. S. A., Los Angeles, Cal., should be addressed.

LEWES, DEL.—The House has reported favorably on the bill authorizing the town to issue bonds for an electric light plant, water works and a sewerage system.

ATLANTA, GA.—J. M. Stephens, of the Board of Electrical Control, of Atlanta, has visited Nashville, Tenn., to examine the city's lighting plant, with a view to erecting a similar plant in Atlanta.

GAINESVILLE, FLA.—The Gainesville Gas Company has secured the contract for lighting the city for five years. It will construct an electric light plant.

FT. PICKENS, FLA.—Bids are wanted April 4 for the construction of an electric lighting system at this post. Communication should be addressed to W. E. Cole, Q. M., Ft. Barrancas, Fla.

AUBURN, ILL.—The Auburn Electric Light Company has increased its capital stock from $8,000 to $10,000.

MARTINSVILLE, IND.—The Martinsville Light, Heat & Power Company has been incorporated, with a capital of $100,000, by Robt. P. King, Merrill Moores and others.

TERRE HAUTE, IND.—St. Louis capitalists have been looking over the ground preparatory to establishing another electric lighting plant in this city, in opposition to the Terre Haute Electric Company. It is thought the St. Louis men will soon apply for a franchise.

MADISONVILLE, KY.—The town of Madisonvile has ordered all electric companies not having franchises to remove all wires, etc., from the streets. The city is attempting to do away with the plant of the Railway, Light & Water Company. Municipal ownership is being agitated.

NEW ORLEANS, LA.—The City Council has passed an ordinance granting the Consumers' Electric Company a franchise to construct and operate an electric light plant.

NEW ORLEANS, LA.—The New Orleans & Carrollton Railway, Light & Power Company has secured the contract for lighting the city for one year at the following figures: $90 per lamp on the overhead system; $100 on the underground system and 12 cts. net per kw-hour for public offices. The total cost for lighting for the year under this contract will be $168,260.

KENNEBUNK, ME.—The Senate has passed the bill to authorize this city to own and maintain an electric light and power plant.

ANSON, ME.—The House has passed the bill granting a charter to the Carratunk Power Company to build a dam, equip a power station on Carrabasset River and light the towns of Madison and Anson. C. O. Sturtevant is said to be interested.

LANSING, MICH.—The United Electric Heating Company, of Detroit, with a capital stock of $100,000, has filed articles of incorporation. The incorporators are Robert, Frank and Guido Kuhn, Louis C. Wurzer and Arthur Gaukler.

CHEBOYGAN, MICH.—The W. & A. McArthur Company will soon require two or three waterwheels for its new water power plant now in the course of construction. The company has not yet given out any contracts for the electrical equipment, but several concerns, it is understood, have the matter under consideration.

COLD SPRINGS, MINN.—The citizens have voted to issue bonds for water works and an electric light plant.

SOUTH STILLWATER, MINN.—The citizens have voted to issue $23,000 bonds for an electric light plant and water works.

COLLINS, MISS.—The Collins Light & Power Company is in the market for a 40-hp return tubular boiler and a 40-hp high-speed automatic engine, of the Ball & Wood or Skinner type, for the electric light plant and water works which the city is about to install.

JEFFERSON CITY, MO.—The Missouri House has passed a bill which enables corporations operating electric light and power plants in cities of 10,000 inhabitants and under to purchase and operate street railways if they are so disposed. The object of the bill is to permit the consolidation of these plants in small cities.

DILLON, MONT.—A. F. Graeter is interested in the construction of an electric light plant.

PRINCETON, N. J.—The Hopewell Electric Light, Heat & Power Company, the Princeton Electric Works, and the Princeton Light Company, of this city, have been merged under the title of the Princeton Lighting Company, with a capital stock of $500,000, and $300,000 in bonds. The officers are: President, C. P. Fitch; vice-president, O. A. Parker; secretary, T. B. Jackson, Jr.; treasurer, Samuel H. Blackwell.

ALBANY, N. Y.—A certificate of merger of the Ravenna Electric Company with the Upper Hudson Electric Company has been filed with the Secretary of State.

NEWBURG, OHIO.—The citizens are considering the feasibility of constructing an electric light system and water works.

ATHENS, OHIO.—On April 6 the citizens will vote on a proposition to issue $15,000 worth of bonds, with which to establish a municipal electric lighting plant.

PRAIRIE CITY, ORE.—The City Council has granted Reveille Bros. a 20-year franchise for an electric light plant.

CONFLUENCE, PA.—The citizens have voted to issue bonds for the construction of a municipal lighting plant.

JOHNSTOWN, PA.—Reagan & Mulock, of Philadelphia, have secured the contract for constructing a subway for the Citizens Light, Heat & Power Co., to cost about $42,000.

KUTZTOWN, PA.—It is stated that the Keystone Electric Light, Heat & Power Company will expend about $25,000 in improvements, including an addition to the power house, an 800-hp engine and an extra set of boilers.

DOYLESTOWN, PA.—The directors of the Newtown Electric Light Company have elected officers as follows: President, A. W. Watson; vice-president, Thaddeus Kenderdine; secretary, W. M. Watson; treasurer, Robert Kenderdine.

HARRISBURG, PA.—Eight electric light and power companies have been consolidated under the name of the United Electric Company, with M. A. Cumbler, of Steelton, as president. The corporations so merged are the Cumberland, the Lower Allen, the Upper Allen, the East Pennsboro, the Hampden, the Camp Hill, the Shiremanstown and the new Cumberland Light, Heat & Power Company.

SUMTER, S. C.—The Sumter Light, Ice & Power Company has been chartered by Perry Moses, president, and others. The capital is $70,000.

ROCK HILL, S. C.—The Rock Hill Water, Light & Power Company has been organized. George MacDonald, of New York, and associates have bought a controlling interest in the company. Extensive improvements are contemplated.

SPARTANSBURG, S. C.—John B. Cleveland and J. N. Cudd, of Spartansburg and other capitalists have secured a blanket charter giving them the right to construct extensive electric power plants, textile plants, etc. The minimum capital is placed at $100,000 and the maximum at $3,000,000.

COLUMBIA, TENN.—John H. Carpenter is promoting a new lighting company at Columbia.

KNOXVILLE, TENN.—The Knoxville Power Company has petitioned for an increase of its capital from $10,000 to $100,000. Its plan is to dam Little Tennessee River and supply Knoxville with electrical energy.

NASHVILLE, TENN.—It is reported that the Nashville Railway Company will secure electric power from the Great Falls Power Company, which proposes to expend $1,000,000 or more in developing Great Falls on Caney Creek. C. H. Fish, of Ohio, is general manager of the company. The General Electric Company is said to be interested in the deal.

DALHART, TEX.—W. H. Wolff, of Gallup, N. M., has secured the franchise for an electric light plant at Dalhart.

LOUISA, VA.—The town is ready to receive bids for the construction of an electric light plant to cost about $3,000.

WILBUR, WASH.—The city council has granted the Wilbur Electric Company a franchise to establish and operate an electric system.

OLYMPIA, WASH.—D. B. Garrison, Secretary of the State Capitol Committee, would like information regarding the installation of an electric light plant.

COLVILLE, WASH.—Geo. Nixon, of Spokane, is making estimates for an electric plant to be installed at Mayers Falls, to furnish electricity to light Colville and other towns.

TACOMA, WASH.—Extensive improvements are being made to the water works and considerable equipment will be installed, including an air-compressor operated by electric motors to furnish air for three new wells. Bids for this equipment are to be invited in the early future.

WHEELING, W. VA.—It is stated that the electric light equipment of the municipal plant is in jeopardy owing to the leaky condition of the roof of the station. Several armatures, it is reported, have been burned out as a result of this condition of affairs. A new roof for the plant, however, is in contemplation.

TORONTO, ONT.—The Canadian Corundum Company, of Toronto, will establish an electric power plant at Bell's Rapids, Ont.

BERLIN, ONT., has voted an appropriation of $100,000 for the establishment of a municipal electric light plant.

STRATHROY, ONT.—Bids will be received March 31 by the Town Council for $50,000 electric light and water works bonds. F. J. Craig. is town clerk.

ORILLIO, ONT.—The Corporation of Orillio has completed a municipal power plant, the first of the kind in Canada. The power is obtained from the rapids of the Severn River, and the plant cost $71,000.

OTTAWA, ONT.—Hon. John Costigan, of Ottawa; Thomas J. Cochran and John M. Stevens, of Edmunton, New Brunswick, are asking from the Dominion Parliament permission to form a company for the purpose of damming the St. John River at the Winding Ledges, and to manufacture and dispose of electric and other power.

MONTREAL, QUE.—One by one the Montreal Light, Heat & Power Company is gathering in all its rivals, projected or otherwise. The latest acquisition is the purchase of the St. Lawrence Power Company. This company controlled the power rights of the Soulanges canal, and it was from this point that it was proposed to develop electric power to the extent of 40,000 hp if necessary. It is estimated that this power can be developed at a very low cost, and it is thought that this consideration has largely influenced the Light, Heat & Power Company in favor of its purchase.

MONTREAL, QUE.—At the recent annual meeting of the West India Electric Company held in this city, Mr. F. L. Wanklyn was elected president. The report of the directors shows a net surplus for the year of $29,265, which amount has been added to the surplus of the previous year, and has been expended in permanent improvements. Contracts have been entered into for the apparatus required for the installation of the third water power unit, the additional line from Rio Cobre to Kingston and the accessory electrical apparatus required for the utilization of this additional power in the city of Kingston.

# THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—J. W. Worthington, of Birmingham, is working upon plans for an interurban electric railway connecting Sheffield, Florence and Tuscumbia in North Alabama.

SHEFFIELD, ALA.—A company has been chartered in New Jersey, with a capital of $500,000, with Henry Parsons, of New York, president, to develop the town of Sheffield, build an electric railway to Florence and supply power for manufacturing purposes.

HARRISON, ARK.—The Ozark & Sulphur Mountain Traction Company has been incorporated. The capital stock is $600,000, of which $50,000 has been subscribed. The officers are: W. G. Gardiner, of Toledo, O., president; Allen Smalley, of Upper Sandusky, O., vice-president; John J. Geghan, of Harrison, Ark., secretary; Neal Dodd, of Dodd City, Ark., treasurer.

CRIPPLE CREEK, COL.—The Pike's Peak & Cripple Creek District Electric Railway Company has been incorporated.

TERRYVILLE, CONN.—The Bristol & Plainville Tramway Company will extend its system to Terryville.

ANSONIA, CONN.—The Connecticut Railway & Lighting Company has prepared plans and specifications for the extension of its system from Ansonia north through the Naugatuck Valley to Seymour, and bids will soon be invited.

GREENWICH, CONN.—The line of the Greenwich Tramway Company from Port Chester to Sound Beach was open for travel on March 21. This is the last link in the continuous trolley service between New York and New Haven. The cars may now be taken at the Battery, New York, and a trolley ride to the Elm City be made without a break.

COLUMBUS, GA.—The Columbus Railway Company has offered to renew its expiring contract for lighting the city at $50 per light per year.

JOLIET, ILL.—The Joliet & Northwestern Electric Railway Company has been organized, with a capital stock of $500,000.

DAVENPORT, IA.—The City Council has granted a franchise to the Illinois & Iowa Interurban Railway Company.

FRANKFORT, KY.—The Bluegrass Traction Company has increased its capital stock from $10,000 to $350,000. The road will be extended from Paris to Lexington.

LEXINGTON, KY.—The Cumberland Valley Interurban Railroad Company has been incorporated to build an electric railway between Monticello and Somerset and Burnsides, a distancee of about 20 miles. The incorporators are W. J. Loughbridge, D. Gray Faulconer, E. B. Ellis, Rudolph Harting, J. H. Carter, W. C. Goodloe, Jr., and E. P. Farrell, of Lexington.

LOUISVILLE, KY.—The franchise for the construction of an electric railway over the Eighteenth Street Road to River View has been sold to the Kentucky Traction Company, recently incorporated. The officers of the new company are: F. P. Killner, president; H. S. McNutt, vice-president; Charles P. Dehler, secretary; Joseph Herman, treasurer; W. L. Weller, Jr., general manager.

JONESPORT, ME.—The Jonesport Railway Company is seeking incorporation. Edward B. Sawyer, George F. Mansfield and William P. Faulkingham are interested.

BOSTON, MASS.—The Bristol & Norfolk Street Railway and the Easton Street Railway have voted to consolidate.

MILLBURY, MASS.—The selectmen of Douglas granted a franchise to the Uxbridge, Whittinsville & Douglas Street Railway Company to build an electric railway to connect the towns named.

BEVERLY, MASS.—Articles of association are being advertised for the North Shore Street Railway Company. The plan of the company is to build from Gloucester, Essex County, to Beverly, a distance of about 18 miles. The capital stock of the company is $250,000.

SOUTH FRAMINGHAM, MASS.—Articles of association have been drawn for the Framingham & Cochituate Street Railway Company, with a capital of $50,000. The board of temporary directors is composed of Chester B. Williams and Frank E. Yeager, of Wayland; Charles A. Coombs and Horace B. Gale, of Natick; Isaac Damon and John Connolly, of Wayland; Abner Jones, of South Framingham.

LANSING, MICH.—A bill has been introduced in the Legislature providing for the construction by the State of an electric railway from the Capitol in Lansing to the Michigan Agricultural College, or for the granting of a franchise by the State for such a line. The distance is about 3 miles.

CONCORD, N. H.—The Hampstead & Haverhill Street Railway, the Epping, Brentwood & Kingston Street Railway and the Goff's Falls, Litchfield & Hudson Street Railway have been incorporated.

TRENTON, N. J.—The Springfield Railway & Light Company, capital $3,000,000, has been incorporated to build railways and electric light plants. The incorporators are Frank R. Hansell, Joseph T. Cutter and William F. Eidell, of Camden.

TRENTON, N. J.—The Philadelphia & Trenton Rapid Transit Company has been incorporated at Harrisburg, Pa., for the purpose of extending the Philadelphia, Bristol & Trenton Street Railway from its westerly terminus at Torresdale to Philadelphia. The capital stock of the company is $42,000, but it is understool that this will be increased soon. The incorporators are J. W. Ellard, Baltimore; Samuel A. Boyle, Jr., and W. H. Drayton, third, Philadelphia; J. D. Orme, of Baltimore, Md., and W. F. Sadler, Jr., of Trenton, N. J.

MAYVILLE, N. Y.—The Chatauqua Traction Company, of Ashville, has been incorporated to operate a street railway between Lakewood and Mayville. The capital stock is $500,000. Among the directors are William Broadhead, S. B. Broadhead and A. C. Wade, of Jamestown.

DUNKIRK, N. Y.—Articles of consolidation of the Dunkirk & Point Gratiot Traction Company with the Lake Shore Traction Company, forming the Buffalo, Dunkirk & Western Railroad Company, have been filed with the Secretary of State. The principal office is in Buffalo. The capital stock of the new road is $305,000, and the directors are Luther Allen, Jay E. Latimer, James W. Holcomb and E. Bingham Allen, of Cleveland, Ohio; William J. Conners, Truman G. Avery, Clarence M. Bushnell, Albert J. Myer, of Buffalo, and Fred R. Green, of Fredonia.

MARYSVILLE, OHIO.—The Delaware & Magnetic Springs Electric Railway Company has been incorporated with $200,000 capital stock.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company proposes to erect a sub-station in Urbana to assist in feeding its northern extension.

CANTON, OHIO.—The Canton-Akron Railway Company has increased its capital stock from $1,600,000 to $2,000,000, to provide for improvements to the system in Canton.

MARIETTA, OHIO.—The Muskingum Valley Street Railway Company has been incorporated with $10,000 capital. Incorporators: B. G. Dawes, H. B. Hoyt, D. C. Gebhart, G. W. Lansley and L. P. Fleming.

CLEVELAND, OHIO.—The Cleveland, Geneva & Meadville Railway Company has been chartered, with $1,000 capital stock, by D. E. Warner, O. C. Pinney, M. E. Patterson, W. R. McConnell and Thomas Davidon, of Cleveland. An option has been secured on a water power at Mechanicsville with a view to utilizing it for operating the road.

CLEVELAND, OHIO.—The consolidation of the Cleveland, Elyria & Western Railway, the Cleveland & Southern Railway and the Norwalk Gas & Electric Company into the Cleveland & Southwestern Traction Company has been accomplished and the following officers of the Cleveland & Southwestern have been elected: A. E. Akins, president; A. H. Pomeroy, first vice-president; S. C. Smith, second vice-president; F. T. Pomeroy, treasurer; E. F. Schneider, secretary.

WILLIAMSPORT, PA.—The Riverside Street Railway Company has been incorporated by M. B. Rich, C. H. Rich and T. M. Stevenson.

WAYNESBORO, PA.—Walter A. MacDonald, of West Chester, Pa., has been awarded the contract to construct the new line of the Chambersburg, Gettysburg & Waynesboro Electric Railway Company from Waynesboro to Pen Mar, a distance of 15 miles.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company will make several improvements in the way of extensions.

NASHVILLE, TENN.—The Nashville Railway Company has applied for an amendment to its franchise granting the power to build extensive new additions in the city.

BARTLETT, TEX.—It is said that plans are being discussed for building an electric railway to connect Bartlett with Corn Hill, Williamson County, and with Saliva, in Bell County.

RICHMOND, VA.—The Virginia Passenger and Power Company, of Richmond, has authorized the expenditure of $80,000 in suburban lines and other improvements

ROANOKE, VA.—A mortgage of $750,000, given by the Roanoke Railway & Electric Company to the Real Estate Trust Company, of Philadelphia, as trustee, has been recorded. There are outstanding $300,000 first and $190,000 second mortgage bonds. A new issue for $750,000 bonds will take up the old bonds and the surplus will be left in the treasury for improvement on the property.

EVERETT, WASH.—W. L. Johnson, of Seattle, Wash., is to apply to the Council for a franchise for the construction of an electric railway here.

SPOKANE, WASH.—It is stated that the entire right of way has been secured by the Cœur d' Alene & Spokane Railway for its proposed line to Post Falls and Cœur d' Alene City, Ida.

HUNTINGTON, W. VA.—The capital stock of the Camden Interstate Railway Company has been increased from $1,000,000 to $2,000,000.

MOUNDSVILLE, W. VA.—Plans are being made for building an electric railway from Moundsville to Williamstown. Guy A. Wagner, of Wheeling, is said to be interested.

CHARLESTOWN, W. VA.—The Charlestown Traction Company is reported to be considering a plan to build an extension to Montgomery, a distance of about 20 miles.

HUNTINGTON, W. VA.—The work of securing the right of way for an electric railway from Washington to the Falls of the Potomac, a distance of 20 miles, has been begun. Jos. S. Miller, John Graham and Geo. F. Miller, of Huntington, are interested.

MADISON, WIS.—The Madison & La Crosse Street Railway Company, recently incorporated, has increased its capital stock from $200,000 to $250,000.

OSHKOSH, WIS.—It is reported that the Emerson-McMillan Company, of New York, has in contemplation the consolidation of the Winnebago Company and the various interurban companies that plan to build lines in this section.

JANESVILLE, WIS.—The Janesville Traction Company has perfected its organization, electing the following officers: H. H. Clough, president; T. S. Nolan, vice-president; R. W. Hill, secretary and treasurer. Application for a franchise is about to be made.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company is said to be negotiating a loan of $1,000,000 to provide for the refunding of outstanding bonds and for the improvement of the company's property in general. It is said that a new power house is to be built, and that the road is to be extended to Plymouth.

CHATHAM, ONT.—At the next session of Parliament application is to be made for a charter for the Chatham, Wallaceburg & Lake Erie Railway Company.

GUELPH, ONT.—Donald Guthrie, solicitor of Guelph, has given notice that application is to be made to Parliament at its next session for a charter for the Guelph & Georgian Bay Railway Company.

## THE AUTOMOBILE.

AUTOMOBILISM IN INDIANA.—A bill has passed the Indiana house which provides that the driver on highways outside cities and towns shall stop upon signal from any passing vehicle and shall remain stationary till the vehicle has passed, and that every automobile owner shall take out a license at the cost of $1 and shall cause his initials to be placed on the back of the machine sufficiently plain to be seen readily.

## NEW INDUSTRIAL COMPANIES.

THE MANHATTAN MOTOR & POWER COMPANY has been incorporated in New York City, with a capital stock of $25,000, by James E. Stout, G. W. Crossman and F. P. Schenck.

THE CENTRAL ELECTRIC AND MANUFACTURING COMPANY, of Youngstown, O., has been incorporated to manufacture and sell electric appliances. The capital is $300,000.

THE ADVANCE FURNACE COMPANY OF AMERICA has been organized at Niagara Falls, with a capital of $100,000. Directors: E. L. Wells, Philip Owen, and C. H. Childs, of Utica, N. Y.

THE SOUTHERN TELEPHONE CONSTRUCTION COMPANY has been incorporated at Jersey City, N. J., with a capital of $50,000. Incorporators: Frank Hart, Charles H. Lemmon, C. Bond Lloyd.

THE ALLEGANY ELECTRICAL CONSTRUCTION COMPANY, of Hornellsville, N. Y., has been incorporated; capital, $150,000. Directors: J. H. Backus, O. E. Vars and H. C. Coleman, Andover.

THE AMERICAN THORIUM COMPANY has been incorporated at Jersey City, N. J., to deal in chemicals; capital, $150,000. Incorporators: Joseph M. Mitchell, Kenneth K. McLaren, Louis B. Dailey.

THE EXCELSIOR DRY BATTERY MANUFACTURING COMPANY, of New York City, has been incorporated, with a capital stock of $30,000. The directors are: Charles F. McShane, George Dolman and D. E. Powers, New York.

THE TUERK MANUFACTURING COMPANY, of Chicago, has been incorporated to manufacture electrical machinery and supplies. The incorporators are William H. Duval, Louis Sallinger and George E. Dickson. The company is capitalized at $25,000.

THE ARDMORE ELECTRIC COMPANY, with a capital stock of $25,000, has filed articles of corporation at St. Louis, Mo. The stockholders are W. N. Mathews, Robert W. Hodge, A. J. Wolverton and C. A. Rose. The company also filed notice of removal from Kansas City and of increase of capital stock from $10,000 to its present capital.

## LEGAL.

RECEIVER APPOINTED.—A temporary receiver has been appointed for the Augusta Telephone & Electric Company, of Augusta, Ga., known as the Strowger Telephone Company. A. W. Blackshear was appointed.

IMPERIAL ELECTRIC LITIGATION.—Mr. W. Gilmore, of the Gilmore Electric Co., of South Boston, Mass., writes us as follows: "We notice a statement in some of the electrical papers that the suit brought by the General Electric Company against Henry A. Truit, Philadelphia, trading under the name of the Imperial Electric Company, has been decided in favor of the General Electric Company. We wish to say that this statement is misleading. The suit has not been decided as yet, a temporary injunction has been allowed, but that is all. The suit will not be decided for some time to come."

## PERSONAL.

HON. W. M. CRANE has been elected a director of the American Telephone & Telegraph Company (Bell system) in place of Mr. John H. Cahill, resigned.

DR. COLEMAN SELLERS, 1301 Stephen Girard Building, Philadelphia, announces that he has admitted S. Howard Rippey to an interest in his general office practice.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio., was in New York this week. The company has just made its report of a most successful year.

PROF M. I. PUPIN is busily engaged developing and improving a large piece of property at Norfolk, Conn., and is making his mark not less as a successful road builder than as an electrical inventor.

LIEUT. E. J. SPENCER, a retired army officer, well-known in the electrical field, has been appointed Grand Marshal of the Civic parade to be given May 2, the third day of the St. Louis Dedication Ceremonies.

MR. H. S. DODD, formerly sales manager in Cincinnati for the General Electric Company, of New York, is now associated with the New York electrical engineering and contracting firm of J. G. White & Company.

DR. CARY T. HUTCHINSON has been appointed a special electrical expert by the New York City Board of Estimate and Apportionment to report on the amount necessary to expend on a city electric lighting plant for street arcs.

MR. W. B. POTTER, railway engineer of the General Electric Company, is taking a trip abroad, and has sailed for Europe. He had of late been actively engaged on the motor and control tests for the New York Rapid Transit subway.

MR. J. M. ZAPATA, of Bilbao, Spain, was a recent visitor at the headquarters of the American Institute of Electrical Engineers. He has gone to Bilbao to become chief engineer of the Sociedad Hidroelectrica of that place.

MR. J. A. MYERS, president and treasurer of the Robbins & Myers Co., of Springfield, Ohio, has been visiting New York City during the past week, in the interests of their large motor and fan trade. The outlook for the current season is excellent.

MR. A. S. SCHULMAN, the Cincinnati (O.) electrical contractor, was in New York last week. He came over from Philadelphia where he has recently secured a contract for the installation of the electrical plant in the new Widener-Elkins office building.

MR. J. L. WAYNE has resigned from the New York Telephone Company, in which he has been engineer in charge of installations, in order to join the teaching staff of the mechanical engineering department of the Massachusetts Institute of Technology.

MR. COLUMBUS O. JOHNSON, ex-water registrar of New York City, has made an interesting and valuable report to the Merchants' Association of New York on the water supply systems of the principal cities of Europe, more particularly with regard to the collection of revenue and the checking of waste.

MR. FRANKLAND JANNUS, the patent solicitor, has sustained a severe loss in the death of his wife, in Washington on March 8. Mrs. Jannus had been ill for two years past, but it was not expected that her complaint would prove fatal. Mr. Jannus has the sympathy of a wide circle of friends in the electrical field and in social New York.

MR. OSCAR T. CROSBY, the well-known electrical engineer, was in New York last week, having lately returned from Mexico, where he met President Diaz. After a short stay at home in Washington he proposes a trip to Thibet, and is now making his arrangements. His previous long expedition was to the hinterland of Abyssinia, in regions where no white man had been seen.

MR. CLARENCE H. MACKAY, the head of the Postal Telegraph and Commercial Cable interests lost his mother-in-law, Mrs. Duer, on Sunday evening, at the Waldorf, the cause of death being paralysis. Mrs. Duer was a granddaughter of the statesman, Reverdy Johnson, of Baltimore. The same Sunday evening a second daughter was born to Mr. and Mrs. Mackay at their Roslyn country seat.

NEW YORK ELECTRICAL SOCIETY.—At the meeting last week, the following members were elected: J. L. Moriarty, Charles E. Mandelick, Charles G. Wingate, Max J. Levy, Robert Lee Hailey, Farley Osgood, W. B. Spellmire, Frederic J. Chisholm, Wm. H. Moon, John L. Flagg, Oskar Friedrich, Joseph Treanor McNaier, John B. Ketcham, Eugene Toussaint, Arthur L. Case and Joseph W. Scott.

LIEUT.-COL. H. A. YORKE, R. A., chief inspecting officer of railways, of the British Board of Trade, who visited this country last year in the fall, has just issued a very interesting account of his trip in blue book form. It is 48 pages, and gives every evidence of shrewd and keen observation. Col. Yorke has many good things to say of American electric railway practice and many useful criticisms to offer.

PROF. W. E. GOLDSBOROUGH, of the Department of Electricity, of the St. Louis Exposition, returned recently after an absence of several weeks. He visited New York, Philadelphia, Baltimore and Washington, attended several conventions and received many applications for space in the Electricity Building. Mr. Goldsborough reports that practically all of the large electrical companies of this country and a number in Europe will exhibit at the World's Fair. The applications from the United States alone are more than sufficient to fill the Electricity Building but foreign exhibitors must be accommodated. Only recently five exhibitors applied for additional space, desiring more than twice as much as they had first asked for.

MR. THOS. A. EDISON.—An item from Washington states that the clerks of the Patent Office began several years ago to keep a systematic account of the patents issued to Thomas A. Edison. They have his various inventions tabulated and indexed, so that they can put their hands on each different idea he has protected by patent from the beginning of his marvelous career of invention. When a pending claim is allowed, as it no doubt will be this month, Mr. Edison will have received 791 patents in all. He is not adding to the list as many ideas nowadays as he did some years ago. Up to 1895 he had taken out 711 patents. Since then he has added to the list from three to twenty-three patents each year. Last year he took out nineteen. This year, so far, he has received six. In ordinary fees for patents Mr. Edison has spent over $51,000.

MR. OREN ROOT, JR., heretofore assistant general manager of the Metropolitan Street Railway system of New York City, has been promoted to the position of general manager of the system. He is only twenty-nine years old. Mr. Root was born in the little town of Columbia, Mo. His father was Professor of Mathematics in the University of Missouri. Oren Root, Jr., was educated at Hamilton College, in Clinton, N. Y., to which his father had removed. In 1895 he entered the service of the Metropolitan Street Railway as a clerk. He attracted the attention of President Vreeland, who determined to teach him thoroughly the street railway business, and sent him out as a motorman, a conductor and gripman. He was gradually advanced through the grades of inspector, car starter, barn superintendent, etc., until he finally became assistant general manager, from which position he has just been advanced. Mr. Root is a nephew of Elihu Root, Secretary of War.

MR. H. O. SWOBODA, electrical engineer of New York City, has just issued a circular part of which follows: "Having during the past twelve months devoted a considerable part of my time to the development of a new and complete line of knife switches, panelboards and switchboards, I am now prepared to enter the market. The National Brass and Iron Works, Reading, Pa., employing about 500 hands in the manufacture of metal goods, have under my supervision equipped an entirely new department with all the latest machines and tools to take care of the manufacture of my entire line and therefore first-class workmanship and prompt delivery can be depended upon. My office at 277 Broadway under the name "The H. O. S. Engineering Company," will take charge of all sales and all engineering work. The designs, electrically and mechanically, no doubt, will meet with approval, as they are based on my experience of the last fifteen years and especially on my experience with the "Falcon" line, so well known in the trade, and of which I am the sole originator."

# Trade Notes.

CHANGE OF NAME.—The Chase Electric Sign Company, of Chicago, has changed its name to Chase Electric Company.

EMERSON MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has just issued a net-price sheet which contains all the data necessary in ordering motors for usual voltages and frequencies.

THE MAGNET WIRE COMPANY, New York, has removed its offices from 141 Broadway to larger quarters at 80 William St. It is increasing its factory facilities and can fill all orders promptly. It carries in stock a full line of trolley, magnet and weatherproof wire.

"INDUSTRIAL" RAILWAYS.—Some applications of "Industrial" railways to boiler rooms form the subject of an illustrated sheet being sent out to the trade by the C. W. Hunt Co., West New Brighton, Staten Island, N. Y. Several views of such applications are given.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has purchased the building and machinery of the J. B. Allfree Manufacturing Company in Indianapolis. It is stated that the price paid for the property was $50,000. The Commercial Company will move into the new quarters in a short time.

EQUIPMENT BULLETINS.—No. 1, of Volume I, for March, 1903, of Johnson's Equipment Bulletin, is at hand. It is sent out by Charles F. Johnson, 908 Ellicott Square, Buffalo, N. Y., and is of special interest to parties who wish to buy or sell rails, motors, equipment, generators, engines, boilers and cars.

MR. F. M. HAWKINS, manager of the New York Office of the Crouse-Hinds Electric Co., Syracuse, N. Y., says that the Norbitt specialties have had an immense sale. In addition to the contracts that he has secured for installations for decorative lighting in this vicinity, the sale of these fixtures with their enclosed contacts has been considerable to contractors.

CENTRE GRINDER.—Messrs. L. M. Heald & Son, Barre, Mass., have recently issued a neat booklet descriptive of their American centre grinder. The subject is illustrated. An illustrated description of the electrically driven centre grinder was published in our issue of Nov. 1 last year. This grinder is made in styles to be driven by hand, friction or motor.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has just placed on the market a new telephone bracket made to attach to the side of a desk so that a desk set may be swung out of the way when not in use. This bracket has a double swing joint and an adjustable clamp whereby it may be made to fit the base of any telephone. It is furnished in oxidized copper.

WESTINGHOUSE ALTERNATING FAN MOTORS.—In a neat booklet just brought out by the Westinghouse Electric & Mfg. Co., Pittsburg, the line of alternating current fan motors manufactured by this concern are illustrated and their principal features briefly described. Some excellent illustrations show the construction of these machines, which are made in the swivel and trunnion type.

FLEXDUCT.—The predominant ideas of the last two illustrated Flexduct sheets issued by the Osburn Flexible Conduit Company, 19 Park Row, New York, are that Flexduct affords superior mechanical protection to wires in exposed places, and that it has great strength and toughness. Both of these ideas are illustrated. Each sheet contains information regarding the properties of Flexduct.

THE EUREKA ELECTRIC COMPANY, of 143 South Clinton Street, Chicago, is sending out a variety of literature which will be of general interest to telephone people. There are three cards containing colored illustrations of two types of wall telephones and one with an illustration of a cable head. A folder gives an illustrated description of the Eureka non-infringing, solid-back transmitter.

THE ASHEVILLE MICA CO. has recently moved into new and much larger quarters. The new place was built specially for its own use and the change was made because of the large increase in its business which necessitated larger space. The company is located at Asheville, N. C., where it deals in cut and uncut sheets of mica, ground mica, washers and discs, and mica made up according to special patterns.

THE ST. LOUIS EXPOSITION is to be formally dedicated on April 30. The only electrical display, it is said, will be one outlining completely the administration Building, over which the flag adopted by the Exposition will be shown apparently waving, by means of commutated lamps. The system to be used for this interesting work is that of the Elblight Company of America, of 114 West 32nd Street, New York City.

THE JAEGER MINIATURE LAMP MFG. CO.—The ever-increasing demand for the high class products manufactured by this firm has again forced it to annex additional floor space of the Bible House, New York City. This is the third increase within a year. The firm is now giving telephone switchboard lamps its special attention, which should be of interest to users of signal lamps in general in the placing of their future orders. Mr. C. T. Jaeger is the manager.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, 118 W. Jackson Boulevard, Chicago, has issued its new catalogue for 1903. The catalogue contains about 500 illustrations of telephones and telephone parts and supplies, besides several full-page views of the offices and different departments of the business. The catalogue is accompanied by a trade-discount sheet. The company furnishes everything for telephone exchanges. A copy of the catalogue can be obtained free by any one on request.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has lately added more warehouse room and has increased its carrying capacity for all kinds of wires for which it is agent. It therefore claims to be able to make very quick and satisfactory shipments on wire. Its assortment is complete in "O. K." weatherproof line and house wires, Paranite and Peerless rubber covered wires, Roebling's, galvanized iron telephone and telegraph wires, and in fact everything in wires.

THE WARD LEONARD ELECTRIC COMPANY reports orders from a large number of machine tool manufacturers for its CK type circuit breaker. With this breaker, the circuit cannot be closed upon overload, and it seems to hit the machine tool trade at just the right point. The company reports also that the theatre dimmer business is coming with a rush. The lighting of a theatre to-day is a most important matter, and the Ward Leonard Electric Company is turning out the highest grade of work.

THE ENGINEERING AGENCY, Monadnock Block, Chicago, was started in 1893 by F. A. Peckham, president. Mr. Peckham, in traveling about the country, was constantly asked by manufacturers where they could find competent help. On the other hand his office was visited every day by those who thought his paper might be able to assist them to positions. The agency has grown steadily and during the past ten years has secured positions for over 5,000 technical men. The registrations during the past two years have exceeded 3,000. A. B. Gilbert is treasurer and A. G. Frost is secretary.

BROWN & SHARPE CATALOGUE.—The Brown & Sharpe Mfg. Co., Providence, R. I., has recently issued its 1903 catalogue of machinery and tools. This catalogue has been thoroughly revised and contains 458 pages, much new matter having been added. The number of tables it contains together with other information of a general character make it especially valuable to workmen as a book of reference. A colored insert contains a list of the principal additions this year to the various lines of machines and tools. A copy of the catalogue may be obtained free upon application.

ECK FAN MOTOR.—The name of the Eck "Hurricane" fan motor has been changed to Eck fan motor and is still being manufactured by the Eck Dynamo and Motor Works, Belleville, N. J. Their sole selling agency has been discontinued and all sales will be made direct from the works. The great success that these fan and power motors have enjoyed for the past seven years has been due to their excellent quality and careful construction. This year, it is stated, they are better than ever. The Eck Dynamo and Motor Works are now ready to quote prices and arrange for contracts for this season's supply.

CLIFTON FIRE-PROOF INSULATING CONDUIT.—The Clifton Manufacturing Company, of Boston, Mass., and the Mackie Steel Tube Manufacturing Company, of Hammond, Ind., have concluded arrangements for the manufacture of Clifton iron insulated conduit. The Clifton Manufacturing Company has devoted much time and money to the perfecting of its insulation, and has in Buffalo, N. Y., a complete conduit factory. The Mackie Tube Company makes a fine line of special tubes, and wrought iron pipe of such quality as to especially adapt it to conduit uses. The Mackie Company will sell the Clifton conduit in the West, Northwest and Southwest from its Chicago office, and the Clifton Company in the East through its New York office at 308 West Street, and its Boston office.

THE K. & B. CO. (Kirkpatrick & Binder), 56 N. 7th St., Philadelphia, have issued an exceedingly convenient little catalogue in folder form. This catalogue shows a number of the various styles and sizes of moulding which they manufacture and carry in stock. The sizes of wire which each size of moulding is adapted for being specified. These mouldings are made in a number of seasoned woods and in three standard finishes, viz., plain, painted, or bright finish. A most valuable feature of the catalogue is several entirely new tables giving the outside dimensions of all the prominent makes of weatherproof, fire and weatherproof, and rubber covered wire, and telephone cables. The convenience and accuracy of these tables are more to be appreciated by the trade. A copy of this catalogue will be sent to any one on request.

A MAMMOTH CATALOGUE.—The General supply catalogue of the Western Electrical Supply Company, St. Louis, Mo., just issued, easily ranks among the largest and most complete volumes of trade literature. It measures 7¼ inches wide by 10½ inches high, contains 714 pages gross, and is gotten up in a very substantial manner. A complete and up-to-date line of general electrical supplies and construction material is illustrated. The contents of the volume can be referred to here only in a general way, by stating that practically everything in the way of electrical apparatus and supplies is listed in a very systematic manner. There are hundreds of typical illustrations, each one being accompanied by a brief reference to the principal features and advantages of the device so illustrated, together with a code for the different sizes, styles, etc., besides prices for each size. This classification extends to supplies for every branch of electrical industry represented, and evidences a vast expenditure of time and labor in its arrangement. The code system is very complete and carefully developed, the index of this feature alone occupying over 24 closely-printed 5-column pages, while the general index takes up over 16 2-column pages. Apart from the great utility of the volume, the Western Electrical Company has good reason to feel proud of its achievement in producing a catalogue of such proportions and in so thorough a manner.

UNION COLLEGE, N. Y.—The Engineering School of Union College, Schnectady, N. Y., is one of the oldest technical schools in the country. Founded in 1845 with Prof. Wm. M. Gillespie at its head, it at once took a high rank and for many years was one of the few engineering schools in America. From the first the evident policy of the school was to adapt the thorough training of l'Ecole des Ponts et Chaussees, where Professor Gillespie had finished his technical education, to the demands of professional practice in a vigorous new country where resources and opportunities were abundant, and capital and professional precedent were wanting. From the characteristics impressed on the school at its foundation it has not departed; mathematics, economics and adaptation may be said to have been the leading subjects in its permanent curriculum. The school has kept pace with the development in American technical education and in the increasing demands on professional training. For many years engineering only was taught; then when the principles of modern sanitary science came to be better understood, a course in sanitary engineering was established, and more recently the course in electrical engineering, now being greatly extended, was undertaken. During its whole history the school has stood for broad, fundamental training rather than narrow specialization, and during recent years since its advanced entrance requirements have made room in the course for them, increased time and attention have been given to culture studies and increased academic training.

# Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 17, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

722,662. GALVANIC BATTERY; M. M. Bair, Levallois-Perret, France. App. filed March 21, 1901. The cover of the cell is held in place by a spring clamp.

722,680. RELAY; W. W. Dean, Chicago, Ill. App. filed July 20, 1900. The relay is intended to maintain the circuit at its points during the existence of an intermittent current. (See page 525.)

722,684. SELF-WINDING ELECTRIC CLOCK; O. A. En Holm, New York, N. Y. App. filed Dec. 11, 1901. Details.

722,701. METHOD OF TREATING GLOWERS FOR ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed June 13, 1901. The glower is shrunk by submitting it to the heat of an arc formed between a plurality of carbon electrodes.

722,702. METHOD OF MAKING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed Oct. 13, 1902. The terminal wire is connected to the glower by molding the latter around the terminal while in a plastic state.

722,727. METHOD OF HEATING RIVETS; H. V. Loss, Philadelphia, Pa. App. filed March 5, 1901. (See Current News and Notes.)

722,728. DEVICE FOR ELECTRICALLY HEATING RIVETS; H. V. Loss, Philadelphia, Pa. App. filed March 5, 1901. (See Current News and Notes.)

722,729. MANDREL FOR CONDUIT SECTIONS; R. W. Lyle, New York, N. Y. App. filed Oct. 17, 1902. A grappling device attached to the mandrel.

722,747. ELECTRICAL HEATING APPARATUS; J. S. Peck, Pittsburg, and K. C. Randall, Wilkinsburg, Pa. App. filed April 6, 1901. (See Current News and Notes.)

722,756. ELECTRICAL APPLIANCE FOR ELEVATORS; J. H. Roberts, New York, N. Y. App. filed Jan. 13, 1903. Automatic stopping switches are arranged in connection with the controller for controlling the movements of the car.

722,772. CURRENT-COLLECTING DEVICE FOR ELECTRIC RAILWAYS; C. A. Terry, New York, N. Y. App. filed December 8, 1896. (See Current News and Notes.)

722,790. SORTING DEVICE FOR ELECTRIC LAMP GLOWERS; A. J. Wurts, Pittsburg, Pa. App. filed May 5, 1902. A machine by which current can be passed through the glowers a sufficient length of time to insure a uniform operative condition after which their resistance can be measured when traversed by a given current in order to determine the voltage to which they are adapted.

722,792. METHOD OF PRODUCING COMPOUNDS CONTAINING SILICON, OXYGEN AND CARBON; E. G. Acheson, Stamford Township, Canada. App. filed Nov. 20, 1902. Heating a mixture of carbon and silica to form a product consisting essentially of silicon, oxygen and carbon in chemical combination. (See page 525.)

722,793. REFRACTORY MATERIAL; E. G. Acheson, Stamford Township, Canada. App. filed Nov. 20, 1902. The product formed by the preceding process. (See page 525.)

722,841. ELECTRICAL MASSAGE APPARATUS; W. F. Hedstrom, Los Angeles, Cal. App. filed Dec. 8, 1902. Details.

722,852. ELECTRIC TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Oct. 19, 1895. A sending device consisting of the primary of a converter connected locally to a source of current, the secondary consisting of two parts wound in opposition, the secondary being connected to the line wire and a shunt circuit around one part of the secondary, provided with means for opening and closing the same.

722,862. TROLLEY; S. H. Limbert, Springfield, Ohio. App. filed May 8, 1902. An arrangement enabling the wheel to maintain its normal relation with the wire in passing around curves.

722,913. ELECTRIC IGNITION DEVICE; N. Schmitt and J. Krannichfeldt, Cologne, Germany. App. filed Feb. 25, 1902. Details.

722,916. MOTOR VEHICLE; G. J. Scott, Philadelphia, Pa. App. filed May 16, 1902. An electric motor having a number of armatures arranged in a circle at right angles to their axes of rotation and field magnets forming a magnetic circuit common to all the armatures.

722,936. ELECTRIC BRAKE SYSTEM; C. E. Barry, Schenectady, N. Y. App. filed Nov. 6, 1900. A series motor having a plurality of field coils normally connected in parallel and means for connecting the motor coils in series in a closed circuit to produce a braking current.

722,946. FRAME FOR BATTERY ELECTRODES; H. Cottrell, Newark, N. J. App. filed Sept. 13, 1902. The frame consists of two corrugated plates into the grooves of which the electrodes are slid.

722,947. ELECTRODE FOR REVERSIBLE GALVANIC BATTERIES; H. Cottrell, Newark, N. J. App. filed Sept. 13, 1902. Comprises an interior portion composed of layers of textile fabric carbonized, as an absorbent of a metallic salt in solution and carrier of a metallic oxide to be made active in the battery, and an exterior portion composed of textile fabric carbonized to form a casing for the electrode.

722,991. RAIL BOND FOR ELECTRIC RAILWAYS; T. Kerr, London, Canada. App. filed Aug. 5, 1901. The fish plate contains a groove in which the bond wire is confined.

722,992. RAIL COUPLING FOR ELECTRIC RAILWAYS; T. Kerr, London, Canada. App. filed Aug. 5, 1901. A modification of the preceding patent.

723,007. REDUCING INDIGO; R. Muller and O. Schwab, Hochst-on-the-Main, Germany. App. filed July 29, 1902. Indigo is subjected to the action of an electric current, in the presence of a sulphite solution.

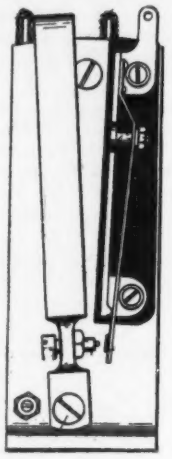
723,016. INDUCTION COIL; A. L. Parcelle, Boston, Mass. App. filed Aug. 15, 1901. A secondary coil, a number of independent primary coils in operative relation thereto and an independent core for each primary coil. (See page 526.)

723,019. FRAME FOR DYNAMO ELECTRIC MACHINES; R. Pfeifer, Charlottenburg, Germany. App. filed Feb. 16, 1902. Details.

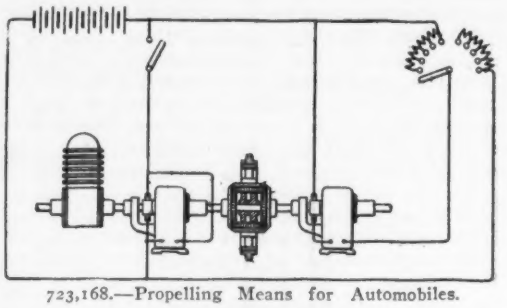
723,032. FUSE PLUG; S. Rothschild, New York, N. Y. App. filed June 23, 1902. Two spring terminals are arranged on opposite sides of an insulating post, over which a fusible ring is passed to embrace the terminals.

723,048. ELECTROMAGNETIC BELL RINGING MECHANISM; J. J. Sheahan, Buffalo, N. Y. App. filed Nov. 3, 1899. A comparatively light current is used in connection with a key-board to control a heavier current which operates the chimes.

723,062. THIRD RAIL INSULATOR; S. B. Stewart, Jr., Schnectady, N. Y. App. filed Sept. 29, 1900. The insulator is provided with projections of relatively small surface upon which the rail rests to prevent adherence thereto by deposits of rust.



722,680.—Relay.



723,168.—Propelling Means for Automobiles.

722,702.—Method of Making Electric Lamp Glowers.

723,076. RECTIFIER; E. Thomson, Swampscott, Mass. App. filed December 15, 1898. (See Current News and Notes.)

723,082. BINDING SCREW; I. S. Turner, Centralia, Wash. App. filed May 22, 1902. Details.

723,115. CIRCUIT BREAKER FOR THIRD RAIL SHOES; M. M. Wood, Schenectady, N. Y. App. filed Aug. 25, 1902. When the shoe runs off the end of a section of a third rail, its dropping movement opens the circuit to the shoe so that contact with other objects will not cause trouble.

723,119. CONTROLLER; T. Von Sweigbergk, Preston, Eng. App. filed April 23, 1902. A series of solenoids so connected together that the effect of each is added to that of the preceding, said solenoids actuating the switch contacts.

723,168. PROPELLING MEANS FOR AUTOMOBILES; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. A gas engine is geared to a generator and connected to one member of a differential gear, the opposing member of which is acted upon by a generator whose torque can be readily controlled, so as to drive the carriage forward or backward at different speeds, the engine meantime working at full speed.

723,183. CIRCUIT BREAKER; R. H. Read, Schnectady, N. Y. App. filed June 29, 1901. The arc at the contacts is blown through tubular electrodes by suddenly generated gas.

723,188. METHOD OF SIGNALING; N. Tesla, New York, N. Y. App. filed July 16, 1900. (See Current News and Notes.)

723,189. RECTIFYING ALTERNATING CURRENTS; E. Thomson, Swampscott, Mass. App. filed December 15, 1898. (See Current News and Notes.)

723,199. ALARM TELEGRAPH SYSTEM; A. Goldstein, New York, N. Y. App. filed April 21, 1900. A system by which fire and other alarms can be sent to headquarters over telephone circuits.

723,205. ELECTRICAL TESTING APPARATUS; H. A. Lewis, Norristown, Pa. App. filed Oct. 14, 1902. A primary circuit containing a generator, one winding of an induction coil and a current interrupter, with a secondary circuit including the other winding of the induction coil, testing terminals and a telephone receiver; the secondary winding and that of the receiver being of a resistance relatively the same as that of the circuit to be tested.